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ON ACETIC ACID AS A SUBSTITUTE FOR ETHYL ALCOHOL IN EXTRACTING THE ACTIVE PRINCIPLES OF SOME OFFICINAL DRUGS.

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(FIRST PAPER.)

In the proposed substitution of acetic acid for alcohol as a menstruum for extracting and a vehicle for preserving and administering the active principles of drugs used in medicine, the very first question is as to the therapeutic equivalency. That is, if the presence of the necessary amount of acetic acid in fluid extracts, etc., can be shown to be therapeutically objectionable, or more objectionable than the necessary amount of alcohol, then it is not proper to make the substitutions.

But acetic acid has long been used for the extraction of cantharides, colchicum, ipecacuanha, opium, squill, etc., without developing any known therapeutical objections, and in a limited experience in the extraction of spices, and of some drugs for veterinary use, it gives extracts practicaliy identical with those from alcohol. The acid has a universally accepted food value, not only as a hydrocarbon, but as a mild acidulous aid in the primary processes of digestion, but in the small quantities that would be present in the doses of fluid extracts, it would be practically inert, or at least as nearly inert as the alcohol which it would replace.

Its properties and value as an antiseptic, deturgent and preservative are well known, but whether it would be present in sufficient

proportion to preserve such preparations from change during a long time has not yet been determined. The oldest set of samples, made with 10 per cent. acid, are now about two years old and apparently unchanged. Fluid extract of ergot, by the officinal process, is preserved by acetic acid in small proportion, as first proposed and used by Prof. Wm. Procter, Jr., in 1857, and in that case an alcoholic preparation very liable to change has been made permanent.

Fluid extracts made with acetic acid menstrua are much more loaded with inert extractive matter than when made with alcohol; and this is a disadvantage, but hardly hurtful, nor more than an inconvenience occasionally.

In compounding prescriptions the acetic acid menstruum has a slight general advantage over alcohol in the amount of precipitation on dilution and on mixing, and in the character of the precipitates, these being more soluble, and containing less resin and fat and probably less of the active principle. In administration there are similar slight advantages over alcohol in that the dilutions with water at the moment of taking the doses are less muddy and unsightly, whilst the acidulous taste is less disagreeable.

From these considerations and from all that is as yet known, it is claimed that there are no serious therapeutical nor administrative objections to a more extended and more general trial of this proposed substitution, especially by the pharmacopœial authorities through the Research Committees.

The chief, though possibly not the only reason for a careful consideration of this proposed substitution is economy in the use of alcohol by the use of a cheaper solvent. The alcohol of the U.S.P., 91 per cent. by weight, costs about $2.40 per gallon of 6 pounds 13 + ounces avoirdupois, or, say, 35 + cents per avoirdupois pound —or, say, 77 + cents per 1,000 grammes.

The acetic acid of the U.S.P., 36 per cent., costs about 10 cents per pound, or 22 cents per 1,000 grammes. When diluted to a strength of 10 per cent., which is the strength most frequently required as a menstruum, the cost is less than 3 cents per pound, as against 18 cents per pound for the Diluted Alcohol of the U.S.P., with which this 10 per cent. acid corresponds—the alcohol menstrua costing six times as much as the acid menstrua to accomplish the same extraction.

In order to measure with a fair degree of accuracy the comparative capacity of alcohol and acetic acid for extracting the active principles of drugs, it was proposed to make parallel extractions of the same drug under the same conditions at the same time. In selecting a drug for the first trial, that is most difficult to extract to complete exhaustion, nux vomica was taken. For the extraction of this important drug the U.S.P. has an excellent formula and process by which the seed is reduced to a powder that passes through a No. 60 sieve—60 meshes to the linear inch—and is percolated to practical exhaustion with a menstruum of about 64·5 per cent. alcohol, to the first part of which a small proportion of acetic acid is added. That is, 500 grammes of No. 60 powder is moistened with 500 c.c. of the alcohol to which 25 c.c. of 36 per cent. acetic acid has been previously added, and it is then percolated to exhaustion with the alcohol without further addition of acetic acid. This powder and menstruum were used on one series of percolations in competition with a 10 per cent. acetic acid on a very coarse powder in a corresponding series of percolations. The weight of 100 c.c. at about 23° C. of the U.S.P. menstruum with acetic acid was 88·70 grammes—without the acid 88·00 grammes, and the same volume of the acetic acid menstruum at the same temperature weighed 101·43 grammes. The percolates were received in 100 c.c. fractions in narrow-neck flasks, and weighed at about this temperature, and the weights of the menstrua subtracted from the weights of the percolates gave the series of differences that are shown in the table to indicate the rates of exhaustion.

About 10 kilogrammes of good, well-seasoned nux vomica was taken from a lot of 2,300 pounds and very coarsely ground so that all of it was passed through a No. 9 sieve. Then half of this was powdered and all passed through a No. 60 sieve for the U.S.P. percolations, thus making sure that the fine and coarse were as nearly alike as practicable. Then each portion, fine and coarse, was carefully assayed, the powder giving 2·80 per cent. of mixed alkaloids, and the ground giving 2·93 per cent. of mixed alkaloids; and therefore 1,500 grammes of the powder would contain 42·00 grammes of alkaloids and the same quantity of ground would contain 43·95 grammes of mixed alkaloids, to be washed out by the different menstrua.

The process of repercolation[1] was used for the extractions, and syphon percolators—and these were so managed that the mass of solid contents was kept entirely filled with the menstruum as indicated by a stratum of menstruum on top of the mass and the percolate rising in the well-tube to near the level of the menstruum on top. This mass in saturation was allowed to stand covered for forty-eight hours when the syphon was put in place and started, being held so high as to draw only from the upper part of the well-tube, and at a rate of dropping so slow as to yield two to three fractions of 100 c.c. each in the twenty-four hours.

If this dropping could be so slow that its rate when multiplied into the whole mass would reduce the downward flow of the liquid between the solid particles to the same rate of downward flow as that which passed through the particles, then the percolation would be ideal, and one stratum of menstruum would pass downward as a piston, and the exhaustion would be complete with the smallest quantity of solvent that could hold all the soluble matters. This principle, underlying all percolation, being kept in mind, the rate was kept slow, and to control loss by evaporation the outer, turned up end of the syphon was kept well within the flask receiving the fraction of percolate.

Three portions of 500 gramme each of each powder—fine and coarse—were taken for the repercolation, and parallel percolations were carried along together, the fine U.S.P. powder with the U.S.P. alcoholic menstruum, and the coarse with the acetic acid menstruum. The percolates were received in long-necked 100 c.c. flasks remarked for that capacity at 23° C. Each fraction as received was adjusted to the mark and weighed, the weighing being done to the nearest centigramme, and the measuring to the nearest tenth of a cubic centimetre.

From the weight of each 100 c.c. fraction the weight of the menstruum was subtracted and the difference noted. These differences

[1] This process of repercolation originated with the writer thirty odd years ago, see *Proceedings* of the Amer. Pharm. Assoc., for 1866, p. 85, and was elaborated through a series of papers on economizing the use of alcohol in extracting drugs, published through several years' *Proceedings* for 1865, p. 201; 1867, p. 391; 1870, p. 166; 1872, p. 182. This last paper is a note on a new form of percolator, and in it the syphon percolator now used for so many years, is first described and figured. The final paper of this series is in *Proceedings* for 1873, p. 548.

make up the following table, which shows approximately the rate of exhaustion as each fraction was received.

The first portion of 500 grammes of U.S.P. fine powder was moistened with the U.S.P. proportion, or 500 c.c. of 64·5 per cent. alcohol, to which 25 c.c. of 36 per cent. acetic acid had been previously added, and macerated for 48 hours in a closely covered vessel. It was then packed in a syphon percolator and 600 c.c. of the 64·5 per cent. alcohol, without acetic acid, was poured on top in successive portions of about 100 c.c. each until a stratum remained permanent on top, and the percolate in the central well-tube stood nearly up to the level of the stratum of menstruum on top. In this condition it was closely covered and allowed to digest for 24 hours. Then the syphon was put in place, started and adjusted so high as to control the rate of dropping to an average of about three or four drops per minute during the day, and very much slower, or at rest, during the night, when the columns in the syphon legs reached a balance, as no more menstruum was poured on top during the night.

The first five fractions after having been separately weighed were added together in a 500 c.c. flask remarked for 23° C., and the few drops needed to make up the measure were added from the sixth fraction.

Then 10 c.c. of this 500 was carefully measured off into a 12 centimetre flat-bottom, tared capsule, and evaporated on a water-bath until it nearly ceased to lose weight. The weight of this extract multiplied by 50 was accepted as the total extract contained in the 500 c.c. of percolate.

The second five fractions of percolate were weighed, the differences taken, and they were then added together and made up to 500 c.c., as before, and then 25 c.c. of 36 per cent. acetic acid having been added, the 525 c.c. was used to moisten the second portion of 500 grammes of fine U.S.P. powder. This was then digested, packed and percolated as the first portion, and the fractions of weak percolate from the first portion first, and fresh menstruum afterwards, were poured on top until the exhaustion was complete, as judged by the weight and taste of the fractions. The fractions of this second portion were managed exactly as those from the first portion, and 10 c.c. of the 500 evaporated to dryness for proportion of extract in the same way, and the capsule and extract were reserved for assay.

The second five fractions of the second portion were put together,

made up to 500 c.c , 25 c.c. of 36 per cent. acetic acid added, and the whole 525 c.c. used to moisten the third and final portion of 500 grammes of U.S.P. fine powder. Then this final third portion was percolated exactly as was the second portion, the fractions of weak percolate from the second being put upon the third, and then fresh menstruum to exhaustion. As the repercolation was not to be carried farther in this instance, there was no present use for the fractions of weak percolate coming from this third portion, except to show the extent and rate of exhaustion—the exhaustion being found to be practically, though not quite, complete after the seventeenth fraction, as judged by the bitterness of the residue and the assays when the percolation was carried on to the twentieth fraction. The first five fractions of this third portion were put together and made up to 500 c.c. as in the other portions, and, by assay, this 500 c.c. was found to represent the 500 grammes of fine powder in the proportions of cubic centimetres for grammes. The second and third five fractions of this third portion were made up to 500 c.c. each and were weighed and assayed for extracts and for alkaloids; and, finally, the seventeenth fraction was also assayed, thus finishing the series managed by the excellent process of the U.S.P. with the alcoholic menstruum, and with such results the principal reasons for substituting acetic acid for alcohol are economy in cost and easier and better exhaustion.

The parallel repercolations to be compared with this U.S.P. process as a standard, were managed exactly in the same way, at the same time, with only the difference that the 1,500 grammes of the same nux vomica was very coarsely ground, and 10 per cent. acetic acid was used as a menstruum instead of the U.S.P. alcohol. The very coarse grinding not only saves much labor, but is essential to the success of the acid menstruum, since with a fine powder the mass is liable to form a mud-like mixture that is not percolable. With this difference only, the description of the U.S.P. process applies equally to that with acetic acid menstruum, and the following table gives the differences in weight for each 100 c.c. fraction, between the weight of 100 c.c. of menstruum and 100 c.c. of percolate. The weight of 100 c.c. of that part of the U.S.P. menstruum that contained the acetic acid was 88·70 grammes. An equal volume of the alcohol menstruum without acetic acid was 88·00 grammes. The weight of 100 c.c. of the 10 per cent. acetic acid menstruum

was 101·43 grammes. These weights added to the differences of the table give the weights of the fractions of percolate.

RATE AND DEGREE OF EXHAUSTION BY DIFFERENCES.

PERCOLATE.	FIRST PORTION.		SECOND PORTION.		THIRD PORTION.	
	U.S.P. Differences. Grammes.	Acetic Acid. Differences. Grammes.	U.S.P. Differences. Grammes.	Acetic Acid. Differences. Grammes.	U.S.P. Differences. Grammes.	Acetic Acid. Differences. Grammes.
1st fraction	3·34	6·03	3·69	7·16	5·89	7·42
2d "	3·66	5·77	4·48	7·26	6·07	7·68
3d "	3·22	5·01	4·53	6·48	5·70	6·69
4th "	2·69	4·42	4·46	6·03	5·54	5·71
5th "	2·09	3·47	3·91	4·83	4·78	5·37
6th "	2·23	2·84	4·29	4·22	4·72	4·86
7th "	1·79	2·17	3·19	2·91	3·50	4·26
8th "	1·33	1·95	2·49	2·02	3·06	3·00
9th "	1·17	1·21	1·57	1·44	2·33	1·97
10th "	1·12	·85	1·43	1·18	1·89	1·52
11th "	·77	·72	·94	·74	1·69	1·02
12th "	·51	·40	·94	·72	1·52	·86
13th "	·37	·06	·70	·53	1·16	·62
14th "	·27	·18	·84	·37	1·00	·72
15th "	·15	·09	·36	·33	·79	·33
16th "	·19	·13	·33	·26	·76	·43
17th "	·11	·05	·34	·29	·65	·27
18th "	—	—	·26	·14	·61	·32
19th "	—	—	·18	·00	·47	·11
20th "	—	—	—	—	·33	·06

The next table deals with the percolates in groups of five fractions each, the measure being made up to 500 c.c. as described above, and these larger fractions were assayed for measure and weight of fraction—for total extract—for chloroform extract and for total of mixed alkaloids.

The most significant showing of this table, and the most important to the proposed substitution, is, that in the first three lines of the table the alcoholic menstruum has extracted 85·3 per cent. of the total alkaloids present, while the acetic acid menstruum has extracted 89·8 per cent. And that in the fifth line the amount of

alkaloids not extracted is as 91 for the U.S.P. menstruum against 27 for the acetic acid menstruum.

Then as a broad general result, it is claimed to have been shown that by the substitution of the acetic acid menstruum for the alcoholic, one-half the cost of grinding, and five-sixths of the cost of menstruum are saved, an equivalent product being obtained in larger quantity.

NUX VOMICA REPERCOLATIONS.

Three Successive Portions of 500 Grammes each for each Menstruum.

500 Gm. Portions.	500 C.c. Percolates.	U.S.P. Menstruum. 64·5 p.c. Alcohol with a small proportion of Acetic Acid.				Acetic Acid Menstruum. 10 p.c. Acetic Acid.			
		Weig't. Gm.	Extract. Gm.	Chlorof'rm Ext'ct. Gm.	Alkaloids. Gm.	Weig't. Gm.	Extract. Gm.	Chlorof'rm Ext'ct. Gm.	Alkaloids. Gm.
1st Portion . .	1st 500 C.c.	457·76	54·80	15·50	10·56	551·20	78·00	12·00	11·19
2d " . .	1st 500 C.c.	463·88	60·00	17·50	12·01	538·10	104·00	16·00	13·74
3d " . .	1st 500 C.c.	471·05	72·50	20·00	14·74	539·69	104·80	21·00	14·65
" " . .	2d 500 C.c.	454·38	30·50	9·50	5·46	521·80	51·50	9·50	4·20
" " . .	3d 500 C.c.	443·36	2·50	1·00	0·91	508·36	4·00	0·50	0·27
" " . .	17th Fraction	88·65	0·40	0·16	0·07	101·70	0·48	0·08	0·06
					43·75				44·11
		Original assays			42·00				43·95

The weighing and measurements of the first three columns of the table are actual upon the scale of the figures given. Those of the other columns were obtained as follows: 10 c.c. was accurately measured off from each 500 c.c. of percolate, and was evaporated until it practically ceased to lose weight. The weight of this extract multiplied by 50 is given in columns four and eight as being the extract present in the 500 c.c. This extract from 10 c.c. was then dissolved in ammoniated alcohol and the alkaloid shaken out with chloroform and ether mixture. The chloroform and ether were boiled off and the extract dried until it practically ceased to lose weight. This weight multiplied by 50 is given in columns five and nine as being the chloroform extract in the 500 c.c. of percolate. This extract titrated with decinormal acid and alkali gave the total alkaloids in the 10 c.c., which, multiplied by 50 gave the figures of columns six and ten. Hence all these figures are subject to the risk of multipli-

cation of error. But when they are compared with the actual assays of the drug percolated, they are as close as could be expected. The original assays were for the U.S.P. fine powder 2·80 per cent., or 42 grammes in the 1,500 grammes of powder against 43·75 grammes as footed up in the table.

For the coarsely ground drug the original assay was 2·93 per cent., or 43·95 grammes in the 1500, against 44·11 grammes as footed up in the table.

It will be seen by the table that the first 500 c.c. of the third 500 grammes of both powders give a fluid extract that represents cubic centimetre for gramme, but 100 c.c. of these will contain 2·8 grammes of mixed alkaloids instead of 1·5 gramme as prescribed by the U.S.P. for its Fluid Extract.

These fluid extracts are both very dark brown liquids, the alcoholic one being much the darker, and after six weeks' standing it is very bright and clear, and has a very small gray deposit. That with the acid menstruum is clear and fairly bright, and without deposit. It has a very distinctly acid odor—stronger of acid than the other has of alcohol, and it contains about 8·1 per cent. of free acid. The dose of the Fluid Extract being about 0·18 c.c., or three minims, this proportion of free acid in it would not be perceptible, and would be entirely insignificant.

The tables show that the acid preparation has a much larger proportion of inert extractive matter, and this would be objectionable if it was largely precipitable on dilution. But it gives much less precipitate on dilution than the alcoholic, and that which it does give is not liable to carry down alkaloids soluble in an acid solution.

Actual experience in the use of preparations made with the new menstruum is as yet not large. Still, throughout the past two years, a steadily increasing number of fluid extracts and extracts have been made and have been confidently supplied and recommended in the veterinary profession where large doses are required, and where diminished cost is of great importance, and where close observation of effects and results are easily made. As a result of this distribution many letters have been received from veterinary surgeons to the effect that the use has been quite successful, and that in the increasing list, now embracing all of the more important extracts and fluid extracts, no drawbacks have yet been discovered.

There has seemed to be no necessity for a new or changed name

for these preparations. They are simply extracts and fluid extracts made with a new menstruum, and when they are recognized by the U.S P., the present officinal names will doubtless remain unchanged, as it is only the menstruum that is changed, the quality and strength being undisturbed. For the present it is considered sufficient to place conspicuously on the label, under the U.S.P. title the words "Made with acetic acid," especially as the new menstruum involves no increase of risk of serious mistakes.

It is proposed that the next paper shall investigate the very important and very difficult exhaustion of cinchona.

THE ASSAY PROCESS.

Early in this investigation it became necessary to have a convenient and fairly accurate process of assay for the mixed alkaloids. The short and easy methods of Messrs. Dunstan and Short, given in the *British Pharm. Journ. and Trans.*, 3d Series, Vol. XIII, pp. 665–1055, and Vol. XIV, p. 621, and given in the British Pharmacopœia, were found objectionable on some accounts, but chiefly because the results are too high. For example, a table is given at p. 1055, wherein from seven samples the percentage of total alkaloids ranged from 3·04 to 3·90 per cent., with an average of 3·29 per cent. This, in the writer's experience, is much too high, and there is a probability that the plus error may be due to weighing the chloroform extract as alkaloids. The most recent authority noticed is the new, 1898, British Pharmacopœia, but its method is liable to the same objection of weighing a chloroform extract as alkaloid. The U.S.P. of 1890 has an excellent method that avoids this source of error by titrating the alkaloids. This method—U.S.P., 1890, pp. 152, *et seq.*—first makes a dry extract and then assays that for use in its standardized preparations.

Two grammes of the dry extract is dissolved by shaking in a separator with 20 c.c. of a previously-made mixture of 2 volumes of alcohol (91 per cent.), 1 volume of water of ammonia (10 per cent.), and 1 volume of water. Then 20 c.c. of chloroform (99 per cent.) is added, and the mixture is agitated during five minutes. The chloroform is then allowed to separate and is drawn off as far as possible by the stopcock. This washing out is repeated with two farther portions of chloroform of 15 c.c. each. The chloroform solutions are then collected in a beaker and exposed on a water-

bath until the chloroform and ammonia are completely dissipated.

Then 10 c.c. of decinormal sulphuric acid is added, stirred, diluted with 20 c.c. of hot water, and when solution is complete 2 c.c. of brazilwood indicator is added. Centinormal potassium hydrate is added until a permanent pinkish color is produced. The number of cubic centimetres of potassium hydrate required is divided by 10, the number found is subtracted from 10, and the remainder is multiplied by 0·0364, and that product by 50, which will give the percentage of total alkaloids in the 2 grammes of extract taken, it being assumed that strychnine and brucine are present in equal proportion, and the above factor being found by taking the mean of their respective molecular weights ($334 + 394 \div 2 = 364$).

This very well designed method was found impracticable in the writer's hands, through difficulty in carrying out the details. The first obstruction encountered was the very nearly constant emulsifying of the chloroform and the constant refusal of the liquids to separate on standing, and the difficulty and loss of time in managing an emulsion once formed. The U.S.P. directs the immiscible liquids to be "agitated," not shaken; yet if shaking be avoided and the agitation be ever so cautiously managed some emulsion seems unavoidable, whilst a degree and kind of agitation that is short of shaking washes out the alkaloids imperfectly. Emulsions that did form were best managed by running them out into a capsule, driving off the chloroform on a water-bath, returning the dark liquid to the separator, and managing the next chloroform with greater care. But a better expedient was found in a recommendation of A. H. Allen and others, to use a mixture of equal volumes of chloroform (99 per cent.) and ether (96 per cent.). With this mixture, used in large quantity, vigorous shaking and consequent effective washing may be employed with little emulsion, if any, at the last of the washings, the separations being very prompt and sharp, usually ready to draw off within half an hour after shaking. The clear chloroform and ether solutions are better managed if drawn off into and boiled off from a flask, as the dissolving, the heating up and the titration are more easily done in a flask. The solution to be titrated is always of a full yellow color, from a bright pale yellow to a deep yellow, with a reddish tint by reflected light, a color in which the first increase of pinkish tint is difficult to

detect, and the want of sharpness and decision in this end reaction is the persisting difficulty with all methods of titration that were tried, but in comparing indicators brazilwood was found to be inferior to logwood. A decinormal potassium hydrate is preferable to centinormal, as it does not dilute the solution of alkaloids so much, while in accuracy of reading it is far within the limit of error of the indicator.

Chiefly in consideration of these conditions the following method was reached and used:

A fair sample of nux vomica is drawn and an average dozen or so of the seed is so milled as to pass through a No. 9 sieve. Of this 10 grammes is weighed off and exhausted with 10 per cent. acetic acid. This exhaustion is easily and conveniently done in a Soxhlet apparatus, but so large an amount of extractive is washed out by the warm acid, that the extract is very difficult to dry, and afterwards at once forms an emulsion that is difficult and tedious to manage. Cold percolation to complete exhaustion gives a much better result, and is not difficult to effect, provided the powder be moistened for packing with not more than 10 c.c. of the acetic acid, and be not packed too tightly.

The percolate is evaporated to dryness on a water-bath, in a large (12 centimetre) flat-bottom capsule, so that the extract is in a thin layer, easy to dry and easy to dissolve. The weight gives the yield of extract.

If a fluid extract or tincture is to be assayed, it is measured, weighed and dried in the same way.

A mixture is made of two volumes of alcohol (91 per cent.), one volume of water of ammonia (10 per cent.), and one volume of water, and of this, 10 c.c. is poured upon the dry extract in the capsule. Then by patiently moving a stirrer over the smooth surface of the dry extract for a quarter of an hour or more, a smooth solution of the extract, easy to wash, is obtained. This is poured into a separator of 150 c.c. capacity, and the capsule and stirrer are rinsed clean with 10 c.c. more of the alcohol and ammonia solution.

A mixture is made of equal volumes of chloroform (99 per cent.) and ether (96 per cent.), and 40 c.c. of this is added to the liquid in the separator, and the whole is shaken vigorously during five minutes, and then allowed to separate. In twenty to thirty minutes the separation will be complete to a sharp line, when the depth of

the upper, dark stratum should be observed and measured. The chloroform-ether solution is then drawn off into a tared flask of about 100 c.c. capacity, and the flask is immersed in a hot water-bath so that the chloroform-ether may be boiled off by the time another washing is ready. In the meantime 40 c.c. more of chloroform-ether has been added to the contents of the separator, and the shaking, separating and drawing off into the flask repeated. This second washing may or may not be then followed by a third, managed in the same way, if required.

If after standing, to separate completely a second time, the dark liquid on top shall be found to have increased in depth, the indication is that emulsion has been formed to that extent, and that the chloroform forming that emulsion holds the proportion of alkaloids present in solution at the time that emulsion was formed, and as the chloroform cannot be washed out of an emulsion, so the alkaloids held by that chloroform cannot be washed out. Therefore, in the case of any considerable amount of emulsion after the chloroform-ether solution is drawn off into the flask, the dark liquid is drawn off into the flat capsule and warmed on a water-bath until all the chloroform-ether is driven off. The dark liquid is then returned to the separator and again washed as before. If a small amount of emulsion again forms, as very rarely occurs, the chloroform in it holds so very little alkaloid as to be within the limit of error of the method.

The tared flask will then contain the total chloroform extract, and the weight of this was long erroneously accepted as the weight of alkaloids.

Then 10 c.c. of decinormal sulphuric acid is carefully measured from a burette into the flask, and is rinsed round and warmed by immersion in a water-bath until the soluble alkaloids are dissolved, when the insoluble residue will show that much of this extract is not alkaloid.

Then 20 c.c. of hot water is added to the contents of the flask, and a definite quantity (10 drops) of logwood indicator. The color is then closely observed by transmitted light, and matched by a similar quantity of liquid in a similar flask. Decinormal potassium hydrate is now dropped in from a burette until the color changes slightly to a pinkish tint or shade of the original yellow by transmitted light, and when this hardly perceptible change is now looked at by reflected light the pink tint is very distinct.

The number of cubic centimetres required subtracted from 10 (cubic centimetres of acid used) gives the number of cubic centimetres of acid saturated by alkaloids, and this number multiplied by the mean of the molecular weights of the two alkaloids (0·0334 + 0·0394 ÷ 2 =) 0·0364, gives the amount of alkaloids obtained from the 10 grammes of nux vomica, the strychnine and brucine being assumed to be present in equal proportions.

Then as 10 is to the product from 10, so is 100 to the percentage of the mixed alkaloids.

EMETINE OCTOIODIDE AND THE EXTRACTION AND ESTIMATION OF ALKALOIDS GENERALLY.

By H. M. Gordin and A. B. Prescott.[1]

In a previous paper[2] we have shown that most alkaloids form definite compounds when treated with excess of iodo-potassium iodide, and that it is possible to estimate the strength of aqueous solutions of alkaloidal salts by means of standardized solutions of iodine and of sodium thiosulphate. In applying this method to the assay of medicinal drugs it is immaterial what method of extraction of the alkaloids from the drug is employed, provided the final alkaloidal solution be sufficiently deprived of non-alkaloidal matter. The simplest and quickest method of obtaining the alkaloidal solution sufficiently free from foreign matter is undoubtedly the method proposed by Dr. A. B. Lyons.[3]

This consists in macerating a weighed quantity of the powdered drug in a definite volume of Prollius' fluid with frequent shaking for several hours, drawing off an aliquot part of the clear liquid, evaporating and taking up the residue with acidulated water. The alkaloidal solution obtained by this method is generally almost perfectly colorless, and can be worked up further for a gravimetric estimation by shaking out the alkaloids with choloroform and ammonia. For our iodometric method the filtered solution can be treated directly with excess of iodine, the excess of which is then estimated by sodium thiosulphate. For the alkalimetric estimation,

[1] In the work of Research Committee D, Section 2, Committee of Revision and Publication of the Pharmacopœia of the United States.

[2] *J. Am. Chem. Soc.*, vol. 20, p. 706, Sept., 1898.

[3] "Manual of Pharm. Assaying," Haynes & Co., Detroit, Mich., 1886, p. 20.

again, the same filtered solution may be taken, using standardized acid in excess and estimating the excess by means of standardized alkali. The only drawback to this method of extraction is the great difficulty of preventing loss by evaporation of the highly volatile solvent, by which loss the volume of the aliquot part becomes reduced and the final figure is liable to be too high.

A GENERAL METHOD OF EXTRACTION.

In order to avoid this difficulty we have worked out an entirely different method of alkaloidal extraction, which can also be used with any one of the methods of estimation as desired. In its main features this method is the same as that which we proposed for the assay of opium.[4] It is carried out in the following manner:

One to four grams of the finely-powdered drug is weighed into a low wide-mouthed vessel with a round bottom, holding eight or ten ounces, and having a well-fitting cork, such as a screw-top ointment-jar.[5] The powder is rubbed up with a small pestle to a fine paste by adding a little of an ethereo-ammoniacal mixture, composed of stronger ammonia water and alcohol each 5 c.c., chloroform 10 c.c. and ether 20 c.c. Then a few more cubic centimeters of this mixture are added, so as to have the drug well covered with the liquid, using in all about five times the amount of the drug taken. The vessel is corked, with the pestle inside, and is set aside for about four or five hours, taking care to agitate by circular movement very frequently during that interval. After that time the cover is removed and the vessel kept in a current of air, stirring frequently till all odor of ammonia has disappeared. With a good draught and frequent stirring the powder will be almost perfectly dry in about two hours. The vessel is then put into a vacuum desiccator over sulphuric acid for about four or five hours.

Any amount of powdered sodium chloride equal to about five or six times the amount of drug employed is then carefully mixed in, with use of the pestle, and the whole thrown into a small percolator, one provided with a glass stop-cock and having a plug of cotton at the bottom.[6] The vessel is then cleaned out several times

[4] *J. Am. Chem. Soc.*, 1898, vol 20, p. 724; *Pharm. Archives*, 1898, p. 121.

[5] An ordinary teacup fitted with a specie cork answers well.

[6] A suitable percolator is easily made out of an ordinary piece of glass tubing fitted with a perforated cork, through which passes a tube having a glass stop-cock.

with small quantities of sodium chloride, and the cleanings added to the percolator. The mixture in the percolator is then covered with a piece of cotton, which is pressed down with a piece of glass, and a suitable menstruum, usually chloroform, is poured slowly into the percolator till the menstruum reaches the stopcock. The latter is then closed, the percolator covered, and set aside for five or six hours. After that time the stopcock is opened, and the drug exhausted with the menstruum, percolating until ten drops of the percolate evaporated on a watch glass, and the residue taken up with a few drops of acidulated water, shows no turbidity whatever on adding a few drops of Wagner's reagent. The percolate is received in a flat evaporating dish, and when finished is placed in a good draught at a temperature of about 30° C. When the liquid is reduced to a very small volume, 10 c.c. of acidulated water[7] is added, and then a few cubic centimeters of ether or petroleum ether, so as to have an ethereal liquid cover the aqueous solution,[8] when the whole is stirred with a glass rod until all the ethereal liquid is driven off. The liquid is then filtered and the evaporating dish and filter washed several times with acidulated water. In this way is obtained a colorless solution of the alkaloid, which can be taken for any method of assay.

In the periodide method of assay the final alkaloidal solution obtained, whether by our method, by Dr. Lyons' method, or by any other method, this final solution representing a definite quantity of the drug to be assayed, is poured slowly and with constant stirring into a flask holding 100 c.c., into which has been previously drawn 20 or 30 c.c. of a standardized solution of iodine and 1 or 2 c.c. of dilute hydrochloric acid[9] (U.S.P.). The flask is then filled up to 100 c.c., stoppered and well shaken till the periodide has separated out. The supernatant liquid is to be perfectly transparent but of a red iodine color. Fifty c.c. are then filtered off, and in this portion the excess of iodine determined by means of standard sodium thio-

[7] If an alkalimetric assay is intended the acidulated water in the operation should be standardized and taken in definite quantities.

[8] If the menstruum is all evaporated off it is sometimes difficult to dissolve out the alkaloids with acidulated water. If chloroform be used, coming below the aqueous layer, it evaporates too slowly.

[9] Except in a case of morphine an excess of acid is not hurtful and even promotes the separation of the periodide. Hydrochloric is preferable to sulphuric acid.

sulphate. The amount of iodine consumed, multiplied by the suitable factor, gives the amount of alkaloid present in the quantity of drug taken.

In the case of several alkaloids being present in the drug a mean iodometric factor can be deduced in the same way as is done in the alkalimetric assay. It is to be noticed that, if there should be no precipitate with iodine, but only a slight turbidity, then the drug is extremely poor and for the assay a much larger quantity than 5 grams should be taken. On the other hand, if after adding the alkaloidal solution to the iodo-potassium iodide solution and separating the periodide by shaking, the supernatant liquid should have very little color or be almost colorless, then it is certain that the drug is very rich, and either a smaller quantity of the drug or a larger quantity of the iodine solution must be employed in the assay.

The method of extraction described above presents particular advantages in those cases where several alkaloids soluble in different menstrua are present in the drug, as by using these menstrua successively a separation of the alkaloids can be easily effected. This principle we have applied to the assay of opium, and it seems also to be applicable to Hydrastis canadensis, upon which we intend to publish a report in the near future.

This method of extraction of alkaloids for assay purposes has given us very good results with all drugs experimented upon, except ipecac root. For some unaccountable reason it is almost impossible to extract completely free emetine, which is liberated in our process by the ethereo-ammoniacal mixture, from this root by percolation. Ether, chloroform and acetone were tried as menstrua, but in all cases the result was much lower than that obtained by Lyons' process.[10] Though the percolation was not interrupted till a few drops tested in the general way with Wagner's reagent gave no reaction whatever, the very low result as compared with that obtained by Lyons' method shows conclusively that the exhaustion cannot be made complete by percolation. This fact would possibly explain why Flückiger,[11] who extracted ipecac by percolation with ammoniated chloroform, obtained exceptionally low results.

[10] It is Lyons' general method, not his modification of Dragendorff's method, that is referred to here.

[11] Pharm. Ztg. 1886, No. 30. See also Guareschi, Einführ. in d. Stud. d. Alkal. 1896, 527.

In the assay of ipecac, given at the end of this paper, the method used was that of Dr. Lyons. The other drugs have been extracted by our method as described above, and the results compared with those obtained by Lyons' method.

The periodide assay method applied to nux vomica, along with a modification of Dunstan and Short's method of separation of strychnine from brucine[12] affords a convenient way of separate estimation of each of these alkaloids in the drug, as follows:

The acidulated alkaloidal solution obtained from nux vomica in any suitable way, and representing 4 grams of the drug, is made up to a definite volume, say 100 c.c. Of this solution 25 c.c., which represent 1 gram of nux vomica, is run from a burette into a 100 c.c. flask in which has been placed 20 c.c. of decinormal iodine solution and 2 c.c. dilute hydrochloric acid, and the amount of iodine consumed by the total alkaloids contained in that 1 gram of nux vomica is reached in the way described above. Let that amount be *a*. If only *the amount of total alkaloids* in the nux vomica is desired it is sufficient to multiply *a* by 47·845 which is equal to one hundred times the mean factor of strychnine and brucine, and the percentage of total alkaloids is at once obtained.

THE SEPARATE ESTIMATION OF STRYCHNINE AND BRUCINE.

For the separate estimation of each of these alkaloids, another portion of the alkaloidal solution, representing 2 grams of the nux vomica, that is 50 c.c., is run out from the burette into an Erlenmeyer flask of the capacity of about 300 c.c., and to the contents of the flask 10 c.c. of a 2 per cent. solution of sulphuric acid is added, and then water enough to make in all about 200 c.c. Then pour in 25 c.c. of a 5 per cent. solution of potassium ferrocyanide, stopper the flask and shake continuously for about half an hour. Now filter, wash the precipitate on the filter repeatedly with water containing 1 per cent. of sulphuric acid, till a few drops of the filtrate diluted with a little water have no bitter taste. The filter is then pierced and the precipitate rinsed with the wash bottle into a 100 c.c. flask. To the contents of the flask is then added 20 c.c. of a 5 per cent. solution of zinc sulphate, and the flask kept on a boiling water bath for about fifteen minutes. The zinc sulphate decomposes the strychnine ferrocyanide, zinc ferrocyanide is precipitated and strych-

[12] Pharm. J. Trans. (3) 14, 290; AM. J. PHAR. 1883, 579.

nine sulphate remains in solution. The flask is then completely cooled, and water enough added to make 100 c.c. Of this 50 c.c., representing again 1 gram of the nux vomica but deprived of the brucine, are then filtered off and run out from the burette into a 100 c.c. flask containing 20 c.c. decinormal iodine solution, and about 2 c.c. of dilute hydrochloric acid. The amount of iodine consumed by the strychnine alone is then determined as above. Let it be *b*. Then $b \times 43.9$ (one hundred times the strychnine factor) gives the percentage of strychnine and $(a-b) \times 51.79$ is the percentage of brucine in the nux vomica.

To test the exactness of this method we prepared a solution containing known quantities of each of these alkaloids and determined these by the described method. The results as can be seen from the following table are fairly satisfactory, if we consider the well-known difficulties of this separation.

The solution contained 0.16 per cent. strychnine and 0.22 per cent. brucine (anhydrous).

Iodine consumed by 10 c.c. before the removal of brucine.	Iodine consumed by 10 c.c. after the removal of brucine.	Found		Contained	
		Strychnine	Brucine.	Strychnine.	Brucine.
0.0843130	0.032397	0.14	0.24	0.16	0.22
0.0843132	0.032397	0.14	0.24	0.16	0.22

Following is a report of drugs which we have so far assayed both gravimetrically and iodometrically. The factors are those given for the higher periodides in our previous paper.[13] For nux vomica the mean factor was taken, which is equal to 0.47845 parts of total alkaloids for 1 part iodine consumed. For ipecac root the factor 0.5453 is used, which is based upon the fact that, as shown at the end of this paper, emetine forms a hydriodide heptaiodide when treated with excess of iodo-potassium iodide.

Taking Lefort and Wurz's formula for emetine we get

$$7 \cdot \times 126.53 : 482.98 :: 1 : \text{factor} = 0.5453.$$

The factors for the drugs of the table are as follows:

Mean factor of strychnine and brucine	0.47845
Atropine	0.2849
Emetine	0.5453

[13] *J. Am. Chem. Soc.*, 1898, **20**, 724.

Drug.		Quantity Taken for Assay. Grams.	Iodine Consumed.	Percentage of Alkaloids.	
				Iodometric.	Gravimetric.
Nux Vomica	Iodometric 1	1	0.0526816	2.52	—
	Iodometric 2	1	0.0526725	2.52	—
	Gravimetric 1	1	Alkaloids shaken out and weighed.	—	2.73
	Gravimetric 2	1		—	2.73
Belladonna Root	Iodometric 1	2.5	0.0459179	0.52	—
	Iodometric 2	2.5	0.0459263	0.52	—
	Gravimetric 1	2.5	Alkaloids shaken out and weighed.	—	0.51
	Gravimetric 2	2.5		—	0.51
Belladonna Leaves	Iodometric 1	5	0.0478286	0.27	—
	Iodometric 2	5	0.0475922	0.27	—
	Gravimetric 1	5	Alkaloids shaken out and weighed.	—	0.28
	Gravimetric 2	5		—	0.28
Ipecac Root	Iodometric 1	2	0.0957764	2.61	—
	Iodometric 2	2	0.0986635	2.69	—
	Gravimetric 1	2	Alkaloids shaken out and weighed.	—	2.63
	Gravimetric 2	2		—	2.62

EMETINE OCTOIODIDE.

Emetine seems to form with iodine two periodides, according to whether the iodine is added to the alkaloid, or *vice versa*, but owing to the lack of material we have only isolated and analyzed one, namely the higher periodide. The emetine used was obtained from Merck & Co. The periodide was made by pouring 200 c.c. of a solution of emetine in acidulated water, this solution containing about ½ per cent. of the alkaloid into about 500 c.c. of a solution which contained about 1 per cent. of iodine with 1½ per cent. of potassium iodide, and was strongly acidulated by hydrochloric acid. The mixture was shaken till the supernatant liquid became perfectly transparent; the precipitate was separated by means of the pump, quickly washed with cold water and then dried, first on porous plates and then in vacuum over sulphuric acid.

Thus obtained the periodide is a dark brown powder, hardly soluble in benzol, ether or chloroform, quite soluble in alcohol and very soluble in a mixture of 4 parts of alcohol and 1 of chloroform. The chloroform greatly increases the solubility of the periodide in alcohol, though chloroform alone hardly dissolves it. So far we have not been able to recrystallize it. On evaporation of the solvent a viscous mass is generally left. Authorities differ with regard to the formula of emetine, as follows:

Lefort and Wurz,[14] $C_{28} H_{40} N_2 O_5 = 482.98$.

[14] *Ann. Chim. Phys.* (5) 12, 247.

Glénard,[15] $C_{30}H_{44}N_2O_4 = 494.96$.
Kunz,[16] $C_{30}H_{40}N_2O_5 = 506.92$.
Paul and Cownly,[17] $C_{15}H_{22}NO_2 = 247.48$.

Our periodide corresponds best to the formula of Lefort and Wurz.

It seems to be emetine hydriodide heptaiodide, $C_{28}H_{40}N_2O_5 . HI_1I_7$.

For the estimation of the additive iodine the periodide is dissolved in chloroform mixed with alcohol and titrated with standardized sodium thiosulphate, using starch as indicator. It is best to add first an excess of the thiosulphate solution, then add considerable water, when the excess is titrated back with standardized iodine. For the total iodine the periodide is dissolved in a little chloroform mixed with a few drops of alcohol; powdered zinc is then added, and the mixture kept on a water bath till effervescence (from the action of zinc on the chloroform) ceases. To the mixture when cold ammonia water is added and the iodine in the zinc and ammonium iodide is estimated exactly as described in the analysis of morphine tetraiodide.[18]

For additive iodine 0.1492 gram of the periodide gave 0.0880045 iodine, and 0.122 gave 0.072725 iodine.

	Calculated for $C_{28}H_{40}N_2O_5 . HI_1I_7$.	Found.
(1)	59.24	59.98
(2)	59.24	59.61

For total iodine 0.1313 of the periodide gave 0.0890502 iodine; and 0.12095 gave 0.0818797 iodine.

	Calculation for $C_{28}H_{40}N_2O_5 . HI_1I_7$.	Found.
(1)	67.69	67.82
(2)	67.69	67.69

CHEMICAL LABORATORY OF THE UNIVERSITY OF MICHIGAN,
November 6, 1898.

[15] *Ann. Chim. Phys.* (5) 8, 233.
[16] *Arch. d. Pharm.*, 225 (1887) 461.232, (1894) 466.
[17] *Pharm. J.* (3) XXIV. 61.
[18] *J. Am. Chem. Soc.*, 1898, XX, 717.

Ammoniacal Collodium for Insect Stings is prepared (*Sudd.-Apoth.-Zeit.*, 1898, 614 from *Bull. gen de Thérap.*) as follows: Liquor ammon. caust. 40 gtt.; collodii, 3.0 gm.; acidi salicylici, 0.3 gm. A few drops of this solution are applied to the place where the sting has occurred.

QUEBRACHO.

By Frederick L. Lewton.

The word "Quebracho," contracted from the Spanish *quebrahacha*, signifying "axe-breaker," is applied in South and Central America to a number of trees possessing a very hard wood, but which belong to widely distinct genera.

The natives mark these distinctions by some prominent characteristic, as for instance the color of the wood, whence the names, "quebracho blanco," "quebracho colorado," "moreno," "prieto," "negro," etc.

There are but two of these which have reached commercial importance: Quebracho blanco, botanically known as *Aspidosperma quebracho-blanco* Schlechtendal, belonging to the order *Apocynaceæ;* and Quebracho colorado, the name applied by the natives to two species of *Schinopsis*, belonging to the order *Anacardiaceæ*.

The first named is found in the Argentine Republic. Its wood is of a light yellow color, of great hardness and durability, and is used in that country for various purposes. The bark, sold under the name of "Quebracho bark," contains several alkaloids of medicinal value as well as tannin. It is used in the treatment of asthma and in the tanning industries.

The medicinal properties of Quebracho blanco have been known for some years but it is of much less commercial importance than the Quebracho colorado.

The latter name is applied in the western part of the Argentine Republic, and a part of Chile to *Schinopsis Lorentzii* (Griseb.) Engler, while in Paraguay and the eastern and southern parts of Argentine, *Schinopsis Balansæ* Engler receives the same name.

The wood of these trees is of a dark cherry color, and takes a most beautiful polish. It is unsurpassed for durability either in air or water, and fence-posts made from only a small stick of it will last a lifetime. Furniture made from Quebracho wood is exceedingly handsome.

But by far the most important use of this wood is as a tanning agent. As the entire log is ground up into a coarse sawdust and thus used, its economic value is much greater than other tanning materials where only the bark of the tree furnishes the desired principle.

While the wood of Quebracho colorado contains from 25 to 28

per cent. of tannin, about 10 per cent. more than is contained in the best sumac leaves, it is mostly used at the present time in the form of extract.

There are large works for producing the extract near Hamburg, Frankfort and in other parts of Germany.

Quebracho extract is manufactured in two forms: A soft paste containing about 45 per cent. of tannin, and a solid extract, called "crystal," containing from 60 to 65 per cent. tannin. The latter resembles kino in appearance and in some of its properties.

About twenty-five years ago tanners in Europe began to experiment with Quebracho, and since that time its use has steadily grown. The consumption of it in the last five years, especially, has increased at an astonishing rate.

CRYSTALS OF SODIUM CHLORIDE IN FLUID EXTRACT OF YERBA REUMA AND A PROXIMATE ANALYSIS OF THIS PLANT.

By Lyman F. Kebler.

A few months ago, Mr. Charles Durnin, who has charge of the fluid extract department of Smith, Kline and French Company, brought me a handful of crystals, with the statement that he had found them in a fluid extract of Yerba Reuma. Crystals in a fluid extract! This is, to say the least, very unusual. On inquiry it was found that the fluid extract was about fifteen years old and considerable of the menstruum had evaporated.

The crystals were cubical, some of them nearly perfect, but amber in color. The form suggested common salt at once, and a taste of one of the crystals left no doubt about its being salt. It was at first thought that possibly a menstruum containing salt had been used in preparing the fluid extract, but a subsequent analysis of the plant dispelled this idea.

Frankenia grandifolia, Cham. and Schlecht., nat. order Frankeniaceæ, is the scientific name for the plant commonly known as *Yerba Reuma*, or *Salt Grass*. The latter name is also a common one for *Bryzopyrum spicatum*. Yerba Reuma grows near the seashore from San Francisco to San Diego and southward; in the deserts of Arizona, Texas and Southern Nevada.

Prof. J. U. Lloyd[1] called attention to this plant twenty years ago. The saltiness and the undesirable name, Yerba Reuma, were commented on. Dr. J. Moeller[2] made an histological examination of this plant four years later, but a chemical analysis is wanting.

Medicinally, the leaves and the stems of Yerba Reuma are used as an astringent stimulant application for catarrhal affections.

The above information led me to make a proximate analysis of the plant. Dragendorff's scheme was followed, in the main. The article of commerce was worked with in this investigation.

A microscopical examination of the powdered material revealed the presence of occasional cubical crystals.

Moisture at 115° C. amounted to 9·92 per cent. All of the subsequent results are based on material dried at 115° C.

The amount of chlorides was estimated by macerating a given amount of the dry material in a definite volume of water, decolorizing an aliquot part with nitric acid and boiling, and the chlorides precipitated by means of a silver nitrate solution, the precipitate, washed, dried, etc., in the usual way. This gave me 17·75 per cent. of chloride, calculated as sodium chloride. I was not prepared to accept this result, so a given weight of the drug was exhausted with warm water and the chlorides estimated as above. This gave 17·10 per cent. chloride calculated as above, or averaging the two we have 17·42 per cent. A remarkably high per cent. of salt.

By carefully incinerating a given weight, ash to the amount of 26·84 per cent. was obtained. Being aware of the presence of a large amount of sodium chloride in Yerba Reuma, and its volatile nature at high temperatures, I determined the amount of this salt yet present in the ash. This amounted to 9·82 per cent., calculated as sodium chloride. Leaving ash, without chlorides, amounting to 17·02 per cent. On adding to this the total amount of sodium chloride, we have an ash amounting to 34·12 per cent. One of the highest, if not the highest ash of plant life on record.

The ash consisted of sand, sodium chloride, potassium sulphate, magnesium phosphate, calcium sulphate, calcium oxide, iron oxide, etc. The above combinations are given as probable.

Some selected material yielded: Sodium chloride, 12·54 per cent.; ash, with chlorides, 23·04 per cent. Moisture, 10·93 per

[1] 1878, AM. JOUR. PHAR., 50, 601; *Proc. Am. Phar. Assoc.*, 26, 707.
[2] 1882, *Pharm. Centralhalle*, 23, 97; AM. JOUR. PHAR., 54, 514.

cent. at 115° C. These data are sufficient to show that the article of commerce varies materially.

The remaining results will be given in condensed form.

Soluble in—	Constituents.	Per Cent.
Petroleum ether	Wax, saponifiable	
	Fat, chlorophyl, etc.	
	M. P. of mixture 60° C.	0·72
Ether U.S.P., 1890	Wax, saponifiable	
	Fat, chlorophyl, etc.	1·00
Alcohol, alsolute	Tannin	2·92
	Extractive	1·90
Water	Sodium chloride	17·42
	Extractive	20·00
Sodium hydroxide, 0·2 per cent. solution, removed		4·71
Hydrochloric acid, 1 per cent solution, removed		3·66
Ash in extracted plant residue		5·03
Cellulose, lignin and allied substances		34·93
Loss and unestimated		8·43
Total		100·00

The medicinal value of this plant lies in the salt and tannin it contains.

35 Poplar Street.

A COMMON ERROR IN RECORDED RESULTS OF PROXIMATE PLANT ANALYSIS.

By Lyman F. Kebler.

I wish to call attention, in this connection, to an error frequently made in recording results of proximate plant analysis. In summing up the results, the percentage of ash is usually added to the per cent. of the other constituents to make up 100 per cent. Some of the ash constituents are soluble in the solvents employed in the course of an analysis. If these soluble constituents are added as ash, they must necessarily be recorded as soluble in certain solvents employed in the analysis, and thus the same substances are recorded twice.

Suppose we take the above analysis of Yerba Reuma and add the ash to the other constituents, and what do we obtain? Not 100 per cent., but 126·41 per cent. An impossibility. This does not allow for any loss of any sort. It is seldom that the error is so much in evidence, yet it is smaller or greater in all plant analysis where the usual method of recording results is adopted.

If an ash must be recorded in the summary, the proper material to estimate it in is the dried residue left after the action of all the solvents employed in course of the analysis. There may not be any ash in some cases, at this point of the analysis.[1]

NOTE ON SPECIFIC GRAVITY.

By T. S. Wiegand.

It may be thought strange by some that a subject taught so fully in our schools and text-books should be brought before the attention of this meeting, but the common things of every-day life and use are those we should understand and study most carefully, and in this opinion we are supported by the most painstaking scientists and pharmacists of all countries. My attention was drawn to the subject when recently reading one of the most recent and best treatises on pharmacy, by a method of taking the specific gravity of substances lighter than water, as it was there described, credited to Mr. Symonds and published in the *London Pharmaceutical Journal* and Transactions, ser. 3d, xix, vol. 1884. As the method is one with which I had long been familiar and was fully explained by the late eminent Dr. Robert Hare, formerly professor of chemistry in the University of Pennsylvania, I referred to his treatise upon chemical philosophy, published in 1828, and there found it described fifty-six years before the Mr. Symonds paper appeared in the above-named periodical.

The readiness with which this method may be performed makes it strange that it has not been taught more generally in the text-books. The process is simply to suspend a glass funnel to a scale pan and let it be immersed just below the surface of the water in a vase below the scale pan, after it is immersed bring it to equilibrium, and then thrust the body, the sp. gr. of which is desired under the funnel, then restore the equilibrium and note the weight necessary to effect this, which added to the weight of the light body, is to be divided into the weight of the light substance in air—this will give the sp. gr. of the light body.

[1 In Dragendorff's Plant Analysis, which is the work generally employed as a guide in carrying on the proximate analyses of plants, he states under the alcoholic and aqueous extractions that the weight of ash should be substracted from the weight of the total residue and the difference reported as the amount of total organic matter for those particular solvents.—Editor.]

While discussing the subject of specific gravity it is worth while to allude to the method of taking the sp. gr. of substances soluble in water.

The substance under examination is weighed in air and then in some liquid in which it is insoluble, the loss in this liquid is divided into its weight in air, multiplied by the specific gravity of the liquid used—this method is noted in the fifth edition of *Parrish's Pharmacy*, p. 78, date of 1884, is also the general rule for all substances whether soluble or insoluble in water.

THE CHEMISTRY OF SASSAFRAS.[1]

By Dr. Clemens Kleber.

Director of the Laboratories of Fritzsche Bros.

The chemistry of sassafras, so far as it has been elucidated by scientific investigations, consists practically of the chemistry of the essential oils that can be distilled from the various parts of the sassafras tree, for, with the exception of a red matter, termed "Sassafrid," which is formed in fresh sassafras roots when exposed to the air, and which seems to be an oxidation product of some tannin-like matter, no other derivative of the plant has, so far, been the subject of chemical researches.

The well-known article of commerce that is called simply "Oil of Sassafras" is distilled exclusively from the sassafras roots, and chiefly from the bark of the root, though also some oil, apparently of the same composition, can be obtained from the wood of the root. The wood and the bark of the stem contain but traces of oil. On the other hand, there are only a very few drugs that contain so high a percentage of volatile oil as does the bark of sassafras root, which yields not less than 6 to 9 per cent. of it, while from the wood of the root generally less than 1 per cent. is obtained.

The oil of sassafras bark, when freshly distilled, is an almost colorless liquid; but when exposed to light and air, it gradually assumes a yellow, reddish or even brown color. Its specific gravity is between 1·07 and 1·08, with an optical rotation to the right, varying from plus 3° to plus 4°, the degree of rotation being lower as the specific gravity rises. It may be of interest to mention in this connection that regularly every spring there appear in commerce

[1] Read at a meeting of the College of Pharmacy of the City of New York.

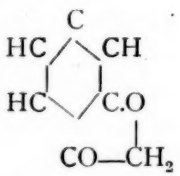
oils which possess abnormal (*i. e.*, too high or too low) specific gravity. Distillers frequently contest the accuracy of the determinations of the specific gravity of their oils with great indignation, for they know that the samples with differing specific gravities were taken from the same tank of oil. The simple explanation for this is, that oil of sassafras consists chiefly of a crystallizable body, safrol, which possesses a specific gravity as high as 1·108; if this body crystallizes from the oil during the cold winter months, it forms, after remelting in warmer weather, a heavy layer at the bottom of the container, which becomes mixed with the bulk of the oil only very slowly. Samples drawn from the top of such a container will, therefore, have a very different specific gravity from that drawn from the bottom of the same vessel. For this reason oil of sassafras should always be well mixed before drawing it off, if it has been exposed to such low temperatures as to crystallize.

If large quantities of oil of sassafras are kept cold for a longer period, safrol will crystallize out in very beautiful, strongly refractory, colorless prisms, which sometimes attain a length of more than 1 foot, and a diameter of 1 inch or more. By repeated treatment in a freezing mixture, with proper fractional distillation of the remaining liquid parts, about 80 per cent. of pure safrol can be isolated from the oil. Pure safrol is an optically inactive, colorless liquid congealing at 8° C., boiling at 232° C., and possesses a pure agreeable sassafras odor.

Its chemical composition is $C_{10}H_{10}O_2$; and, extended chemical study has proven that it is the methylene ether of an allyl-pyro catechin:

$$CH_2 = CH.CH_2$$

Safrol:



DERIVATIVES OF SASSAFRAS OIL.

If treated with oxidizing agents, it yields, among other products, by oxidation of its allyl to the aldehydic group CHO, a substance that is highly appreciated in perfumery, the well-known piperonal

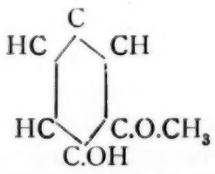
or heliotropine, and by further oxidation piperonylic acid. When safrol is boiled with alcoholic potash, its allyl group, $CH_2 = CH.CH_2$, is transformed into the isomeric propenyl group, $CH_3CH = CH$, thus forming iso-safrol, a substance generally similar to safrol, but of a less agreeable odor, a higher boiling point, 247° C., higher specific gravity and higher refraction to light. Upon oxidation it also yields piperonal and piperonylic acid, but with considerably greater ease, for which reasons it forms the base for the technical manufacture of heliotropine.

Those parts of sassafras oil which remain liquid even in a freezing mixture, can be separated into their constituents by fractional distillation. In this way a considerable fraction is obtained, boiling between 155° and 175°, which consists chiefly of pinene, $C_{10}H_{16}$, that terpene which is found so generally in volatile oils, and which forms the greater part of oil of turpentine. It can easily be identified by its crystalline nitrosochloride and by the easily crystallizable benzylamine and piperidine compounds of the latter. Besides pinene, a small amount of another terpene, $C_{10}H_{16}$, is present, which forms a solid, but very unstable addition product with nitrous acid, by which reaction it is recognized as phellandrene, a terpene also very frequently met with in essential oils.

The higher boiling fractions of sassafras oil contain about 0·5 per cent. of a body which can be extracted by means of a diluted solution of alkali. When set free from this solution by sulphuric acid, it forms an oil, which by its clove-like odor and the formation of a benzoyl compound melting at 69° C. can be identified as *eugenol*, the characteristic constituent of oil of cloves. Eugenol $C_{10}H_{12}O_2$, is distinguished from safrol only by possessing two additional atoms of hydrogen in its empirical formula. In its structural composition it is also closely allied to the latter, being the methylic inste d of the methylenic ether of the same phenol:

$$CH_2 = CH \cdot CH_2$$

Eugenol:



We therefore are led to suppose that safrol and eugenol are generated in the plant by nearly allied processes.

Those fractions of sassafras oil which boil in the neighborhood of 200° C., upon cooling yield an abundance of colorless prisms, which, after proper purification, can be recognized as common dextro-camphor $C_{10}H_{16}O$, by their melting-point, odor, optical rotation and the formation of a well crystallizing oxime melting at 115°. In one authentic specimen of sassafras oil as much as 6·8 per cent. of camphor has been found by reduction of the camphor to borneol, $C_{10}H_{18}O$, acetylizing the latter with acetic anhydride, and saponifying a weighed amount of the acetylized oil.

The highest boiling fractions of the oil seem to contain a small amount of a sesquiterpene $C_{15}H_{24}$ according to certain color reactions apparently *cadinene*, the presence of which, however, has not yet been proven beyond all doubt.

The composition of oil of sassafras bark may therefore be summarized as follows:

	Per cent.
Safrol, $C_{10}H_{10}O_2$	80
Pinene, Phellandrene, $C_{10}H_{16}$	10
d-Camphor, $C_{10}H_{16}O$	6·8
Eugenol, $C_{10}H_{12}O_2$	0·5
Cadinene, (?) $C_{15}H_{24}$, and residue	2·7

Attention might be called to the singular fact that all these compounds contain ten atoms of carbon in the molecule, with the exception of cadinene, which has half as many more. It seems also that this circumstance points to an intergenetic relation of these various products of the same plant. Another coincidence which should not pass unnoticed, is, that oil of sassafras bark in its qualitative chemical composition closely resembles oil of camphor, which is, however, not so surprising, seeing that the sassafras and camphor trees belong to the same plant family.

This similarity in composition has been for some time familiar to chemical manufacturers who seized the opportunity for producing substitutes for oil of sassafras from the oily by-products of the manufacture of camphor. As a result, artificial (?) commercial, oils of sassafras are nothing else than fractions of Japanese camphor oil, of about the same specific gravity, 1·07, as that of the natural oil. Such substitutes are, for their cheapness, very largely used, especially by soap manufacturers. Pure safrol, which is produced commercially from the same source also finds a considerable use in

chemical industry as well as in medicine. For medicinal purpose safrol is even preferable to oil of sassafras, as it always has a uniform composition and its purity may be easily determined by the usual tests. On the other hand, the natural oil always shows some variation in composition.

OIL OF SASSAFRAS LEAVES.

In addition to the root bark oil, the composition of which we have already considered the sassafras tree also produces another essential oil which does not appear in commerce and which in part seems to have been distilled but once for the purpose of chemical examination, namely the *oil of sassafras leaves*. It is quite well known that sassafras leaves when crushed exhale a rather strong and very agreeable odor. The quantity of oil that can be extracted therefrom by steam distillation, is, however, only very small, amounting to only 0·028 per cent. of the weight of the fresh leaves. The oil has, when fresh, a greenish yellow color, turning to a reddish brown with age; it has a much lower specific gravity, 0·873, than the bark oil, an optical rotation of plus 6° 25′, and a very agreeable odor somewhat resembling oil of lemon and oil of citronella. The characteristic odor is indeed due to the presence of the same aromatic bodies which exist in the latter oils, for chemical examination has proven that the oil contains a considerable amount of citral, $C_{10}H_{16}O$, and geraniol $C_{10}H_{18}O$. Citral, the source of the lemon odor, can be isolated by taking advantage of the fact that it forms a compound with sodium bisulphite; and geraniol, the alcohol from which originates the rose-like odor of the oil of citronella, oil of geranium and oil of roses, may be identified by the formation of a solid compound with calcium chloride. Besides this, another alcohol, isomeric with geraniol, has been isolated, namely linalool. This alcohol is found associated with geraniol, in many essential oils, and, when present either in the free state or as an ester of acetic or of valerianic acid, is the source of the sweet odor of oil of linaloe, oil of lavender and oil of bergamot. Derivatives of these two alcohols are also present in oil of sassafras leaves, in the form of their acetic and valerianic esters. Apart from these highly aromatic principles, the oil also contains several terpenes, namely pinene and phellandrene, considerably more of the latter than is present in the bark oil; there is also, apparently a considerable amount of some hydrocarbon

$C_{10}H_{16}$, which belongs to the "aliphatic terpene" class. These bodies are highly interesting, but so far have not been completely investigated. They are hydrocarbons with an open chain of carbon atoms containing three double bonds, and are characterized by a low specific gravity, high refractive power (compared with ordinary terpenes) and excessive tendency to polymerize. This peculiarity renders their investigation very difficult. It is not unlikely that they form the mother substance of quite a number of other constituents of essential oils. In the highest boiling parts of sassafras leaf oil some cadinene seems to be present, and also a paraffin-like substance melting at 58° C. Such paraffines are often found in oils distilled from leaves, as in oil of Gaultheria and otto of roses; the latter contains so large an amount that the paraffines crystallize out at even a moderate temperature.

Reviewing this enumeration of the chemical constituents of the two oils from sassafras, we find therein a striking and interesting example of the ability of some plants to produce, in their various parts, oils which are fundamentally different in their chemical composition. It would be very desirable if extended researches in this direction could be made with other aromatic plants, as such investigations would probably throw some light upon the question which so far has been found unanswerable: How does the plant produce the great variety of complicated substances, the mixture of which constitutes its essential oils?

THE PHARMACOPŒIAL STANDARD FOR BELLADONNA PLASTER.

By Carl E. Smith.

In a recently issued pamphlet published by Johnson & Johnson, entitled "Red Cross Notes," an article appeared treating of Belladonna Plasters, in which was discussed, among other matters, a paper contributed by the writer to the April number of the American Journal of Pharmacy, representing a report on analyses of commercial belladonna plasters, made under the auspices of Research Committee D., Section II., of the Committee of Revision of the U. S. Pharmacopœia.

The statement is made in this pamphlet, that in an attempt to establish a standard for belladonna plasters an error was made by the

Committee as to the pharmacopœial requirements, in that extract of belladonna leaf was mixed with *twice* its weight of plaster mass, instead of mixing it with *four* times its weight of mass, as demanded by the Pharmacopœia. This is based upon the statement in the report above-mentioned, that in order to test the accuracy of the method used for the valuation of the commercial plasters, an assayed extract of belladonna leaf was mixed with twice its weight of a plaster vehicle consisting of rubber, resins, etc., the mixture then being assayed to determine whether or not all alkaloid could be recovered. It will be apparent to any one reading the report attentively, that the mixture was made merely for this purpose, and not, as it is made to appear in the pamphlet of Messrs. Johnson & Johnson, to prepare a typical standard plaster. It would not have been possible to prepare a plaster meeting the implied requirements of the Pharmacopœia from the extract used, by adhering to the proportions directed, since its strength, about 1·15 per cent. of alkaloids, was considerably lower than might reasonably be expected from a leaf extract of average quality. The U. S. Pharmacopœia of 1890 requires the plaster to contain 20 per cent. of extract of belladonna leaf, this standard being approximately the same as that of the U. S. Pharmacopœia of 1880, which demanded that the plaster represent its own weight of belladonna leaf. Since experience has shown the average yield of extract from the leaf, when made with the official menstruum, to be about 22 per cent., the two standards differ but little, and as a specimen of belladonna leaf containing less than 0·3 per cent. of alkaloids is, by general consent, regarded as below the average, a belladonna plaster falling much below this strength must also be regarded as deficient.

No attempt was made by the writer to fix a definite standard of strength in the report referred to, but in commenting on a tabulated list of analyses of commercial plasters included in it, it was stated that a certain number of the samples assayed were much below the U. S. Pharmacopœia standard of strength. As these samples were found to contain from 0·042 to 0·125 per cent. of alkaloids only, no one can with reason object to the characterization of these as being below the implied pharmacopœial requirements.

The writer wishes to take this opportunity to correct any false impression that may possibly have been created in the minds of some of those reading the last paragraph of a note on belladonna

plasters in the June number of this JOURNAL. The paragraph in question referred to the authorship of the method for assaying belladonna plasters, used by the writer in the valuation of commercial plasters reported upon in the April number of this JOURNAL, and there credited to Messrs. S. W. Williams and C. E. Parker, as joint authors. As some readers of the June note may have inferred that Mr. Williams had failed to give credit to Mr. Parker for his share in devising and improving the process, it is due to Mr. Williams to state that both special and general credit was given to Mr. Parker in the original publication of it by Mr. Williams in the *Proc. of the Am. Ph. Ass.* for 1890. The more recent improvements in the method have been made by Mr. Parker.

MEDICO-CHIRURGICAL COLLEGE,
PHILADELPHIA, November, 1898.

RECENT LITERATURE RELATING TO PHARMACY.

CONSTITUENTS OF OIL OF LEMON GRASS.

W. Stiehl (*Journ. Prakt. Chemie.*, 1892) reports the results of his investigation of lemon grass oil, the product of Andropogon citratus. From this oil, Schimmel & Co. (1888) prepared an aldehyde which they termed citral, and which Semmler (*Berichte* **24,** 201) proved identical with his geranial, isolated from the oil of Andropogon schœnanthus. Dodge (*Am. Chem. Jour.*, **12,** 553) isolated by means of sodium bisulphite, an aldehyde which he terms citriodoric aldehyde, and lastly Barbier and Bowvault (*Compt. rend.*, **121,** 1,159) isolated a third aldehyde, which they called l–licarhodal.

These three aldehydes Stiehl has carefully studied. He separates them from the oil by sodium bisulphite, with which they all unite. When sodium hydrate is added to the mixture, geranial separates as a crystalline compound, citriodoric aldehyde dissolves; while l–licorhodal (or allo-lemonal, as Stiehl calls it) separates as oil. The three aldehydes are differentiated by the melting points of their compounds with semi-carbazid and of their naphtocinchonic acid derivatives and by the boiling points of their acetone condensation products.

All three possess the formula $C_{10}H_{16}O$, and are aliphatic bodies with the following probable constitution formulas:

Geranial $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!\diagdown\!\!C = CH - CH_2 - CH = \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - CH_2 - CHO$

Citriodoric aldehyde $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!C{=}CH{-}CH_2{-}CH_2{-}\underset{\displaystyle CH_3}{\underset{|}{C}}{=}CH{-}CHO$

Allo-lemonal $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>\!C{=}CH{-}CH{=}CH{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}{-}CH_2{-}CHO$

Only the last named is optically active, and this rotates the ray of polarized light to the left.

Geranial cooked with sodium acetate is converted into the two other aldehydes, and these on treatment with dilute acid, go over into geranial.

The existence in the oil of a fourth aldehyde of cedar-like odor and of high boiling point is announced, but no extended work has yet been done. H. V. Arny.

AROMATIC WATERS.

E. Ewers reports (*Apoth. Zeitung.*, XIII, 75, 76) an investigation touching the quantitative estimation of volatile oils in aromatic waters. Finding extraction with ether and evaporation of ethereal solution of the oil, either by heat or by passage of air through the container, invariably gave uncertain results, he tried extraction of the oil from 400 c.c. of the water (in which was dissolved 25 per cent. sodium chloride) by agitation with 50 c.c. petroleum ether (B. P. 50°) evaporation of 25 c.c. of the separated benzin solution by passage of air through the container, in which was placed 0·1 to 0·15 gramme olive oil.

The fixed oil, he claims, retains the volatile oil admirably, and his experiments at extraction of aqueous solutions of known strength of volatile oil, even when containing 10 per cent. of alcohol, gave almost quantitative results.

He then estimated the oil strength of three aromatic waters, fennel, peppermint and cinnamon, which he prepared after formula of das "Deutsche Arzneibuch," by distillation of the drug in various stills and under differing conditions; distillation from water alone; from water through which live steam was passed; and lastly, with live steam, no water being mixed with the drug. He also, in the case of fennel and peppermint, prepared waters by rubbing the oil with calcium carbonate and water and subsequent filtration. The result of his assays expressed in grammes to the liter, are:

Fennel . .	0·188 (from Levant fennel) to 0·4	(Thuringia fennel) normal,	0·3
Peppermint	0·270	" 0·740	" 0·5
Cinnamon	0·710	" 1·370	" 1·0

Comparisons of method of distillation show the best results are to be expected in waters condensed in a worm rather than in a straight condenser, and from those processes where the drug is mixed with water in the still body, rather than subjected to live steam. Also, finely cut drugs yield a better product than those coarsely comminuted.

Waters prepared from oil and calcium carbonate assayed :

Fennel	0.215 to 0·225 grammes to liter
Peppermint	0·417 to 0·562 " " "

H. V. A.

POISONOUS CHARACTER OF PURE WATER.

H. Koeppe (*Apoth. Zeit.*, 1898, 713, from *Deutsche Med. Wochensch*) notes that distilled water is decidedly deleterious to protoplasm, absorbing from the same saline constituents and swelling its tissue, even to the extent of destroying the vitality of the cells.

Distilled water has a similar action on the cells of the stomach, producing in some cases vomiting and catarrhal troubles. After citing Kohlansch's standard of absolute purity of water—the minimum conductivity to an electric current—he shows by this method that many varieties of natural water from melted ice—especially from glaciers—are purer than ordinary commercial distilled water ; as is also the water of a spring at Gastein, which is said to be poisonous and which chemical analysis finds absolutely free from deleterious matter.

He therefore concludes that the toxic properties of this water is due to its absolute purity, which also explains why the sucking of ice and the drinking of glacier water sometimes causes stomach derangement. H. V. A.

IDENTIFICATION OF THEOBROMINE.

M. Francois (*Jour. Pharm. et Chimie*, 1898, 521) gives the following tests of identity and detection of impurities.

0·10 gramme dissolved in a mixture of 1 c.c. nitric acid and 2 c.c. water, becomes cloudy on addition of 10 c.c. solution of silver nitrate (10 per cent.).

It clears on warming and crystallizes on cooling.

A hydrochloric acid solution when treated with bromine water, and the excess of bromine driven off, becomes blue on addition of a trace of ferrous sulphate solution (10 per cent.) and a few drops of ammonia water. Caffeine shows this reaction, however.

Acicular dark green crystals of theobromine tetraiodide are formed when the alkaloid, dissolved in hydrochloric acid, is treated with normal iodine solution, the precipitate separated from the supernatant liquid, redissolved in potassium iodide solution (10 per cent.) and allowed to crystallize.

He gives as the most important test the scant solubility of theobromine in 95 per cent. alcohol. The most saturated alcoholic solution, even after agitation for forty-eight hours at 21° C., contains only 0.0045 grammes in 10 c.c.; while caffeine, the most likely adulterant, will dissolve at 21° C. in proportion of 0.093 gramme to 10 c.c.

This slight alcoholic solubility will detect the presence of almost all other organic adulterants, save starch; such sophistications being usually quite soluble in alcohol. Starch is detected by its insolubility in cold diluted hydrochloric acid; inorganic matter by its ash. H. V. A.

TESTING SODIUM BICARBONATE.

Skubich (*Apoth. Zeit*, 1898, 644) reports trials of the various methods of detecting sodium carbonate in the bicarbonate.

He finds Kublis' test—the cloudiness produced when a quinine solution is added to bicarbonate solution, that contains carbonate—is unsatisfactory; as is also Ley's test; the turbidity produced in a solution of bicarbonate containing carbonate.

On the other hand he approves the test of the German Pharmacopœia—the absence of red tint, when phenolphtalein is added to a solution of 1 gramme bicarbonate in 20 c.c. water, to which has been added 0·2 c.c. normal acid.

As precautions, however, he notes that some new glassware is sufficiently alkaline to redden phenolphtalein, and this factor must be eliminated; that temperature affects color, solutions decidedly red at 30° C. being colorless at ·0° C.

Taking absolute bicarbonate and adding thereto definite quantities of carbonate solution, he establishes the approximate value of

the test, finding after adding the prescribed amount of normal acid, the red color appears only when over 2 per cent. of carbonate is present; in fact, when the normal acid is omitted, the red color appears only when the amount of carbonate is over 0·5 per cent. This data reckoned for the U.S.P. test shows it permits 1·6 per cent. carbonate.

He further investigated the quantitative estimations of carbonate in bicarbonate, finding unsatisfactory the method based on amount of residue after red heat, absolute bicarbonate yielding 63·1 per cent. of original quantity, and titration of this residue with normal acid and methylorange. Dietze's method was also uncertain; but satisfactory in every respect was Küster's method, which is as follows: To a solution of 1 gramme bicarbonate is added 20 c.c. normal potassium hydrate, part of which is used in converting the bicarbonate into the normal carbonate. To this is added 10 per cent. solution of barium chloride (about 40 c.c.), part of which precipitates as carbonate, while another part reacts with the excess of KOH; an equivalent amount of barium hydrate being formed. This is estimated by titration with normal acid and phenolphtalein, when the quantity of excess potassium hydrate, and therefrom the amount of that reagent used in converting the bicarbonate into carbonate can be deduced; the factor of the latter being 0.084 grammes bicarbonate to each c.c. of normal alkali employed.

In conclusion, he finds commercial bicarbonate usually contains only 1 to 1·5 per cent of normal carbonate. H. V. A.

PHARMACOLOGICAL NOTES.

THERAPEUTICS OF PODOPHYLLIN.

Dr. Hector W. G. Mackenzie and Dr. Walter E. Dixon (*Edinburgh Med. Jour.* for November, *vide New York Med. Jour.*, December 10th) conclude from their researches that Indian podophyllin (obtained, we suppose, from Podophyllum Emodi, *Wallich*) is an active purgative and a useful therapeutic agent, that it may be substituted for P. peltatum; but it is important that the physician should know which sample he is providing, as the Indian variety is nearly twice as physiologically active as the American.

That the active principles contained in the crude resin are two substances:

(*a*) Crystalline podophyllotoxin.

(*b*) Podophylloresin (podophyllinic acid?).

Both of which act as excellent laxatives in small doses, without secondary constipation or other objectionable symptoms.

Other authorities (*vide Proceedings Amer. Phar. Asso.*, 1895) do not agree with above, but state it to be unsatisfactory and not an adequate substitute for P. peltatum. C. B. L.

SCOPOLAMINE AND ATROSINE.

Otto Meyer, of Breslau (Klin. Mon. f. Augenhl., Jan., 1898), as result of his comparative experiments upon these two drugs in pathological cases states: That 1 per cent. solutions of atrosin acted more strongly in iritis than an atropine solution of the same strength, and two cases of synechia yielded to it which had previously been treated with scopolamin without effect. Both drugs cause an increased tension and slight irritation, and the effect on the accommodation is about the same in both. Occasionally after the use of either drug, slight toxic symptoms, such as vertigo, flushing of the face, disturbance of the pulse-rate, dryness of the fauces and an uncertain action on the accommodation, were noticed. They are practically allied drugs, and under the same conditions in which hyoscyamine is converted into atropine, scopolamine is converted into atrosine.—*Boston Med. and Surg. Jour.*, November 17, 1898. J. L. D. M.

RECOVERY FROM A LARGE DOSE OF HYDROCYANIC ACID.

Kolipinski reports a case of recovery from hydrocyanic acid. A man aged 42, neurotic and melancholic, took, with suicidal intent, ½ ounce of the official acidum hydrocyanicum dilutum U.S.P., containing 2 per cent., or 4·8 grains of anhydrous acid. He was found twenty minutes later lying on his bed in a deep coma, etc. The treatment consisted of a subcutaneous injection of $\frac{1}{40}$ grain sulphate of atropine, 10 grains citrate caffeine by enema, and 4 or 5 enemata containing each a teaspoonful of aqua ammoniæ in half a cup of water. Consciousness returned in two hours. In twelve hours he was in his normal condition, outside of dysenteric stools for a few days, the result of the ammonia injections.—*Med. News*, December 10, 1898. C. B. L.

THE DOSAGE OF BELLADONNA AND NUX VOMICA.

At a meeting of the Manchester Medical Society, Dr. D. J. Leech, one of the most learned of British pharmacologists, related some

investigations to show that accurate dosage with the official preparations of belladonna and nux vomica—the preparations contained in the B.P.—was impossible before the recent revision of the Pharmacopœia. This was due to the fact that however carefully such preparations were made, their strength varied widely, owing to the difference in the amount of alkaloid contained in the drugs in a crude state. The alkaloid contained in the 1885 edition of the British Pharmacopœia varied from $\frac{1}{900}$ to $\frac{1}{75}$ of a grain. In the standardized preparation of the new edition of the British Pharmacopœia, published this year, the width of the limit has been greatly lessened. The largest dose of the new tincture, 15 minims, corresponds to $\frac{1}{150}$ of a grain of the alkaloid, the largest dose of the alcoholic extract to $\frac{1}{100}$.—*Philad. Med. Jour.*, November 28, 1898.

C. B. L

CHLOROFORM POISONING.

D. T. Marshall, M.D. (*Medical News*, November 19, 1898), reports a case of chloroform poisoning, in a woman 40 years of age, from the internal administration of 10 minim doses of chloroform until 40 minims were taken. The patient was found in a semi-unconscious state, but could be aroused to speak incoherently. Her pulse was very slow and irregular, and her respiration slow and sighing, and at times stopping altogether, but starting again after vigorous slapping of the chest. Hypodermic injections of strychnine, digitalis and whiskey in repeated doses were resorted to, the patient receiving in the space of an hour and a half, strychnine sulphate, ·22 grains; tincture of digitalis, 9 minims, and whiskey, 4·5 drams. In addition to hypodermic medication, the patient's face and chest were bathed with cold water and the chest was slapped with a wet towel. Artificial respiration by Sylvester's method was resorted to and the feet were bathed in hot water. Later, the faradic current was made use of, applications being made over the chest and heart. Toward the end of an hour the patient showed signs of strychnine poisoning—*risus sardonicus* and spasmodic respiration. These symptoms became very marked, but as the patient again relapsed into unconsciousness, the strychnine injections were repeated. At the end of two hours the effects of the chloroform subsided, the patient making a complete recovery in two days.

J. L. D. M.

EDITORIAL.

PHARMACOLOGY.

In these days, when so much is known concerning the universe, it is impossible for it to be said of anyone as it was said of Milton and Homer by Sydney Smith, that they had mastered all the knowledge of their day. The division of the labor in this storehouse of knowledge among what have been called "specialists" in certain departments has made it apparent that "a jack of all trades must be master of none." It is true that there are few departments which do not share something in common with another and by the association of the workers in many departments with each other some mutual benefits are bound to arise. But this close relationship, which one department shall have with another, must be carried on with discretion if the greatest benefits are to accrue to each. While we ought not to say that we have no interest whatsoever in any department that apparently does not concern us; the interest of the specialist, however, in another department is solely that of a "hobby," or with the hope that a ray of light from this source may illuminate his chosen vocation.

The pharmacist has been so situated that it has been required of him that he should know something of nearly every department. He is supposed to be acquainted with the trades, arts, sciences, ethics, etc. His training and education has been largely with the people of the neighborhood who have come to him for the solution of their daily difficulties. At college, however, his training has been chiefly on the principles required for his calling as a compounder of medicines. The great problem of our educational institutions is how far ought this training along broad lines extend. It is safe to say that it ought to extend so far as to make our knowledge of some value for good and not dangerous.

It ought to startle all of us when we consider the information that is coming to light regarding the making and employment of remedial and other agents in the case of the sick and diseased, how much suffering and even death have probably been caused by reason of ignorance. The therapeutical action of many of our drugs apparently has long been known, but the sciences of pharmacognosy and chemical assay are only now being developed. Pharmaceutical preparations have been made, but out of what and containing what has been a mystery and necessitated the conflicting statements among therapeutists regarding the value of drugs. Do we wonder at this when investigators like Dr. Houghton (*Jour. Amer. Med. Assoc.*, April, 1897) find that "out of twenty-seven samples of crude Indian cannabis, of excellent physical appearance, only thirteen proved to be active when administered to animals; and of a large number of preparations tested, at least one-half were inert. Is it any wonder that physicians believe that hemp is one of the most unreliable of drugs? Or that we occasionally have alarming symptoms following its administration? Digitalis leaves and strophanthus seeds are other good illustrations, and many other good examples might be cited if space permitted."

In the same article Dr. Houghton says: "Without pharmacological knowledge the application of remedies must ever be attended with the greatest uncertainty. As a pure science, pharmacology has taken rapid strides during the past few years; but to the physician, by their dating the manner in which the functions of the various organs of the body may be influenced by the therapeutic agents at his disposal, it has given the greatest gain. Empiricism is

disappearing and ultimately we shall realize the hope of centuries and medicine may justly claim a position among the exact sciences.

"It is not my purpose to show what pharmacology has done in the past, but to call attention to some of the ways in which the science may be of still further service in the future. A physician may be ever so well versed in therapeutics, but if his prescriptions are filled with inert drugs, or drugs varying in strength, his efforts may be useless or even dangerous. In the past the pharmacist has greatly aided in efforts by improving the preparation of the various remedies. But the time will soon come when he should be held responsible not only for the chemical and botanical purity of his preparations, but also for the physiological activity of those important medicinal agents which cannot be standardized by chemical methods."

"Probably to the physician the most important duty of the pharmacologist, in his relation to the manufacturing pharmacist is the examination of the crude drugs and active principles before they are made up into fluid extracts, tinctures, pills, etc. Only these crude drugs and active principles should be tested physiologically which cannot be assayed by chemical means. But there are quite a number of the most important medicinal agents that the chemist must at present pass, without testing, as no characteristic reactions have been worked out for them. Examples will best illustrate this point. As is well known, ergot, the sheet anchor of the obstetrician in so many hours of peril, loses much of its activity in a comparatively short time after being harvested, and if kept under certain conditions may soon become entirely inert, or if the crude drug was good when it came to the manufacturer, the menstruum used may have been such that the more important constituents were left in the improperly exhausted drug; consequently the physician is never quite sure whether the preparation he carries in his obstetric bag can be relied upon to aid him in stimulating an exhausted uterus in a difficult labor, or in checking a much-dreaded post-partum hemorrhage. How much better it is for all concerned to test the ergot physiologically, rejecting the drug if found inert. Then to complete the precautions, the finished product should be again tested to make sure that it shows the active properties manifested by the crude drug."

"It is much more important to the physician that he have a physiologically active preparation than an elegant pharmaceutical preparation. The ideal preparation is the one that possesses the properties of activity and elegance in the highest degree."

Sufficient has been said to indicate that whatever the training of the pharmacist may be, the physician shall require of him preparations that have been made with the best skill of the pharmacist with drugs that have been carefully examined by the pharmacognosist and respond to the tests of the chemist or pharmacologist, or both, as the case may be. Everything which appertains to the pharmacology of drugs concerns and interests the progressive pharmacist as well as physician, as the latter will no doubt soon universally demand information in many cases concerning their physiological assay in preference even to their chemical assay, and at least in connection therewith.

Aromatic Principles of Coffee and Tea are not shown by the investigations of Lehman to manifest any physiological action.—*Pharm. Centralh.*, 1898, p. 679.

REVIEWS AND BIBLIOGRAPHICAL NOTICES.

A TEXT-BOOK OF MEDICAL AND PHARMACEUTICAL CHEMISTRY. By Elias H. Bartley, B.S., M.D., Ph.G. Fifth edition, revised and enlarged. P. Blakiston's Son & Co., Philadelphia, 1898.

The contents of this book are divided into five parts. In Part I are presented such fundamental facts in chemical physics as are necessary for a proper understanding of the descriptive parts of the book, and of the theories and uses of thermometers, hydrometers, the spectroscope, medical batteries, etc. Part II is a well arranged and full treatise on theoretical chemistry. Part III treats of the inorganic chemistry of the most important elements used in medicine. Part IV deals with organic chemistry, poisons and their antidotes, and incompatibilities. Part V is devoted to the consideration of ferments, nutrition, foods and diet, digestion, the examination of milk, gastric contents, vomit, feces, urine, urinary sediments, and other matters of physiological and clinical chemistry. The book also contains an appendix, in which are given the rules for the spelling and pronunciation of chemical terms adopted by the American Association for the Advancement of Science, and, in addition, tables of weights, measures, specific gravities and solubilities. A glossary of uncommon chemical terms and an index complete the volume.

In preparing the present edition the author has revised the text of the fourth edition and rewritten some portions of it, especially the parts on organic chemistry and physiological and clinical chemistry.

The first edition of this book appeared in 1885. It was designed especially as a text-book for medical students during their attendance upon lectures. But since the title now points to a proposed use of the book in another and distinctly different field from that of a guide to the student of medicine, the work comes before us under conditions which necessitate the viewing of it from two different standpoints.

We think the book is a desirable one for the medical student, for it puts in his hands a store of well-selected matter which should be taught in the lectures on chemistry in the medical schools, and which the physician should thoroughly understand before beginning practice. In treating the subjects, the author has kept in mind the exigencies requiring a knowledge of chemical facts which are likely to arise in medical practice, so that throughout the book we find much good advice to the practitioner; notable instances of this are in regard to the treatment of acute poisoning, and the physician's duty in cases of criminal poisoning. In this connection it may not be out of place to say that we would like to see the books on poisons recognize the fact that petroleum benzin is occasionally an accidental or intentional inebriant nowadays, and designate proper antidotes to it. We think the statement, on page 327, to the effect that solutions of volatile oils in alcohol in the proportion of 1 in 5 are termed essences, while those in the proportion of 1 in 50 are called spirits, may perplex the student, since it is not in accordance with the authority of the United States Pharmacopœia, which gives the terms essence and spirit as synonyms; and, beside, none of these official preparations are prepared in the proportions named. And, again, we think the subject of Fowler's solution is dismissed, on page 192, without sufficient consideration of its composition and arsenical strength to afford the student the knowledge he should have of this medicine.

In condensing the subject-matter of Part III for the medical student the author has omitted mention of some processes which are important to the pharmaceutical student. For instance, no mention is made of the official and the other processes used on a large scale for the preparation of solution of hydrogen dioxide, yet a knowledge of such methods is essential to an understanding of the tests of purity given by the United States Pharmacopœia for this substance. The preparation of the so-called colorless tincture of iodine by means of ammonia water is given on page 130, but no reference is made to the use of sodium thiosulphate, which is as frequently employed in making this preparation, in fact, authorized by the National Formulary in conjunction with ammonia water. We believe also that the description of processes is in some cases too abbreviated for the information of the pharmaceutical student, who should be taught to master the mechanical requirements as well as the chemical details of processes; *e.g.*, the description of acidum sulphurosum, United States Pharmacopœia, on page 162, comprises no instruction for the washing of the sulphur dioxide, or its absorption in cold water.

Another defect of the book, in our opinion, is the inconsistency of the atomic weights used; thus, in the case of zinc there are three different numbers employed to represent this value, as shown on pages 86, 270 and 273. The list of atomic weights used in the book is not the one recognized by the United States Pharmacopœia. While we would not use the last, nor any other, authority as a chock to the wheels of progress in deducing the correct atomic weights, nor in any other department of investigation, at the same time, we believe the student would be less confused by studying the same numbers for the atomic weights, both when he reads his general chemistry, and when he goes to the laboratory to do the testing of the United States Pharmacopœia, with its official volumetric solutions, the strengths of which are based upon the atomic weights of a certain list.

There is another matter in which the author indulges to some extent, and to which we must call attention. It is the frequent use of the nearest whole number instead of the mixed number, which is supposed to represent the atomic weight of an element. This practice is altogether a too common one among authors of books on chemistry. If teachers and authors actually believe these numbers to be exact values, they should always insist on the use of the fraction, and not take the responsibility of decreasing or increasing them, simply to enable a student to remember the numbers, or to shorten a calculation somewhat. If the student violates his sense of accuracy by altering the atomic weights in the said manner, let it be at his own bidding.

On account of the objections cited against this part of the book, we cannot recommend it as a guide to the pharmaceutical student.

We note a typographical error on page 444, where C is used instead of Ca.

JOSIAH C. PEACOCK.

THE BRITISH AND COLONIAL DRUGGISTS' DIARY, 1899, 44 Bishopsgate Without, London, E.C.

This is the fourteenth annual issue of the British and Colonial Druggists' Diary, and contains matter of permanent utility for reference. Among the new features of this year's edition are a list of "Photographic Formulæ" and an article on "Electricity as a Hobby." The work will serve the purpose of ref-

erence for the pharmacist, where time requires that he have works of this character within his reach.

THE CHEMISTS AND DRUGGISTS' DIARY, 1899. 42 Cannon Street, London, E.C., Melbourne and Sydney, Australia.

The first Diary of the Chemist and Druggist was issued in 1868, which contained many of the features which are in this one. One of the more recently introduced features is the "Buyers' Guide." The longest section of the Diary is a "Commentary and Criticism of the British Pharmacopœia." This is an epitome of the criticisms as well as much new material in this Pharmacopœia, especial attention being given to the manufacture of chemicals, the preparation of galenicals and descriptions of commercial varieties of drugs and how they are imported. The diary is arranged for daily use and is a valuable reference work for the busy pharmacist, who will find the information contained herein both useful and reliable.

PROCEEDINGS OF THE PENNSYLVANIA PHARMACEUTICAL ASSOCIATION. Twenty-first annual meeting held in the Buena Vista Spring Hotel, Franklin County, June 21-24, 1898.

A very full account of the proceedings of this State Association has already been given in this JOURNAL. The work of this Association in scientific and educational, as well as in social matters, leaves nothing to criticise. One of the most interesting features of this meeting was the presentation of a gold medal to Charles A. Heinitsh from his friends, commemorating the completion of fifty years' activity in the drug business. A fac-simile of the medal is given above.

SEMI-ANNUAL REPORT OF SCHIMMEL & CO. Leipzig and New York, October, 1898.

This report contains a record of the most important scientific work done on essential oils during the past six months. There are a number of valuable critical notes on recent papers concerning terpenes and essential oils. We will incorporate in the JOURNAL later some of these notes and reviews.

YEAR-BOOK OF PHARMACY. Comprising abstracts of papers relating to pharmacy, materia medica and chemistry, contributed to British and foreign

journals from July 1, 1897, to June 30, 1898. With the transactions of the British Pharmaceutical Conference at the thirty fifth annual meeting, held at Belfast, August, 1898. London : J. A. Churchill. 1898.

The account of the proceedings of thirty-fifth annual meeting of the British Pharmaceutical Conference has already been given in full in the September issue of the JOURNAL. The Year-Book comprises abstracts of papers on pharmacy and related branches as well, mention of new processes, preparations, etc., which have been introduced during the year mentioned. This part of the work includes about 268 pages, and represents a fairly good summary of the work of the year. One feature enhances the value of the book considerably, and that is its publication so soon after the Conference and the close of the year to which the work relates.

COLLEGE OF PHARMACY OF THE CITY OF NEW YORK.

The regular quarterly meeting of the College of Pharmacy of the City of New York, was held in the Lecture Hall of the College on Tuesday evening, October 18th. Caswell A. Mayo, Chairman of the Special Committee on Papers, reported on behalf of that Committee that pursuing the policy outlined by the previous committee, another American drug—sassafras—had been taken up. Dr W. A. Bastedo introduced the subject by his paper upon the botany of the sassafras tree. He dwelt upon the general botanical character of the plant and alluded to the labors of Miss Katherine C. Burnett, in distinguishing between root and bark of sassafras in a powdered condition. The following notes are based upon her report :

In the root bark the cells are large and thin-walled, and filled with starch. Pores are not seen at all. In the powder the cells are much broken up, and the starch grains largely set free. These starch grains are nearly spherical (if subjected to any pressure they become angular) from ten to fifteen microns in diameter and have the hilum a little to one side of the centre. They are rarely single, and are usually found in groups of from two to five. The bast-fibres are few and are generally detached.

In the stem bark the cells are smaller, thick-walled, contain no starch, and generally hold together in patches. Pores are numerous and distinct. There are many bast-fibres, and these are not detached, but are joined to square thick-walled cells. By these differential characters an adulteration of root bark with 10 per cent. of stem bark can be detected.

Clemens Kleber, Director of the Laboratories of Fritzsche Brothers, delivered an address upon the chemistry of sassafras, which is published in full in another part of this JOURNAL (page 27). Following this address, Prof. Geo. C. Diekman, of the College of Pharmacy, presented some notes upon the pharmacy of the drug, which had mainly to do with the pith and its products.

The chairman, Mr. Mayo, then read the paper by Professor Lloyd, of Cincinnati, on the history of sassafras. The notes collated by Professor Lloyd give a very complete review of the drug in its historical aspects. The chairman concluded the subject by presenting the paper prepared by Mr. Velsor on the commerce in the sassafras bark.

MINUTES OF THE PHARMACEUTICAL MEETING.

PHILADELPHIA, December 20, 1898.

The regular pharmaceutical meeting was held in the Museum of the College, with James T. Shinn in the chair.

The first paper presented was on "Some Observations on Fluid Acetracts in Comparison with Fluid Extracts," by Wm. B. Thompson, which will be published in a later issue of this JOURNAL. After making some general observations on the adoption of new methods and procedures, the author considered the respective merits of alcohol and acetic acid as menstrua and solvents in pharmaceutical operations. One marked feature which he noticed in fluid acetracts was the absence of a certain gravity and density as compared with the corresponding fluid extracts, as also a striking difference in the color of the two classes of liquids. In cases where the density of the fluid acetracts was more pronounced, the odor of the drug appeared to be masked by the acetous odor. To illustrate the subject more fully, some of the individual members of each class were considered as to physical appearance and also therapeutic activity in a few instances.

Some interesting points were brought out in the discussion of this paper, and among those participating in it were Dr. C B. Lowe, Professor Remington, Mr. Kebler and the chairman. Professor Remington said that he was glad that the use of acetic acid was attracting attention; that he had been experimenting with this solvent for the past twelve years. He did not agree with all the conclusions of the author, but thought that he had been fair in his treatment of the subject. He said, in addition, that it was necessary to make observations, and that the truth was what we want. He himself was somewhat conservative, and he did not believe that acetic acid could take the place of alcohol, but that some drugs could be exhausted with it, and that probably one-half of the official preparations could be made with this solvent. With reference to the solid preparations, the "acetracts," he said that they were sure to be used, as the acid acted as a solvent for the alkaloids; that Mr. F. B. Kilmer had tried acetract of belladonna for making belladonna plaster, and found it to be 20 per cent. stronger than the ordinary, the reason being that probably soluble salts of the alkaloids were formed, and thus it was more effective. The statement was also made that some of the physicians of this city were trying this class of preparations, and that they had obtained distinctly noticeable results. The speaker then referred to the efficiency of acetic acid in exhausting nux vomica (the whole beans being used by Dr. Squibb), and stated in this connection that a large manufacturing firm of this city had been using it for a number of years. Finally he alluded to a recent editorial in *Merck's Report* on "Acetracts *vs.* Fluid Extracts," and read portions therefrom, which were humorous, to say the least.

Replying to a question by Dr. Lowe, Professor Remington said that glacial acetic acid was an excellent solvent for volatile oils, and that such solutions were being used by candy manufacturers for flavoring their products.

Mr. Kebler referred to the work of Cripps and Paul and Cownley along this line. They found that in an acetract of ipecac, made by reducing it to powder by evaporation, there was a lowering of the percentage of alkaloid to the extent of $\frac{1}{4}$ to $\frac{1}{5}$; while, on the other hand, a powder made with hydrochloric acid lost none by heating.

An interesting communication on "Pharmacopœial Preparations from an Economical Standpoint" was read by Wm. L. Cliffe, in the absence of the author, Chas. H. La Wall. Several questions pertaining to the economical side of pharmacy were taken up by the writer, but the one which is of vital importance and which seems the most difficult to adjust is that of compensation for service rendered. As stated by the author, the opinion seems to prevail among the laity that the pharmacist realizes immense profits on everything he sells. Such an opinion is very far from the truth, however, as shown by the arguments used. In conclusion, the author said that increased requirements for pharmacists should be accompanied by increased remuneration for services rendered, and that no true progress can be made until equilibrium is established in this direction. This paper will appear in a later issue of this JOURNAL.

Those remarking on the subject of this paper were Messrs. Thompson, England and Kebler.

A "Note on Specific Gravity," by Thos. S. Wiegand, was read by Wm. B. Thompson. (See p. 26.)

Mr. Kebler said that in taking specific gravity it is important to observe certain conditions; as, for instance, that of temperature, in order to obtain concordant results; this also applied to other constants.

Having continued his work for the Committee on Revision of the Pharmacopœia, Lyman F. Kebler presented in abstract a paper having the following title: "The Physical and Chemical Properties of Lithium Benzoate and Lithium Salicylate." Some rather interesting results were reported by the author, as well as some important recommendations in regard to testing the above salts, but these will not be dwelt upon here, as the paper will be published in full in a subsequent issue of this JOURNAL.

The following were exhibited: A sample of excellent saffron grown in Lebanon County, Pa., and another of the best commercial saffron offered in this country. These were sent by Jos. L. Lemberger, of Lebanon, for purposes of comparison, the Lebanon County saffron being considered by him to furnish the type for this drug on account of its freedom from contamination.

In reply to a query as to why saffron should be kept moist, Mr. England said that it was probably on account of volatile oil.

Mr. W. S. Weakley, a student of the College, reported the presence of a resin in the stigmas, and it was suggested that the presence of this constituent might contribute toward the effect produced on the eyes of those handling this drug.

Specimens of a species of Lemna, or duckweed, which grows in the canals and ditches of Holland, were received from Prof. J. B. Nagelvoort. This species, known as the red Lemna, is said to be very abundant there and to have encroached on the territory of Lemna polyrhiza, the most common species. Owing to its color in the fresh state, which is said to vary from the common red brown of Fe_2O_3 to the more reddish tinge of Sb_2S_3, the ditches have more the appearance of roadways than of waterways.

Mr. Kebler reported that in a consignment of aconite which he recently examined four bails assayed well, while one was found to contain 25 per cent. of tormentilla, specimens of the aconite and of the adulterant being exhibited.

On motion, the meeting adjourned.

FLORENCE YAPLE, *Secretary pro tem.*

✻ CLASSES ✻

OF THE

PHILADELPHIA COLLEGE OF PHARMACY,

Seventy-eighth Annual Session, 1898-99.

FIRST YEAR CLASS LIST.

Name.	*Place.*	*State.*	*Preceptor.*
Armstrong, Albert Buchanan,	Chester,	Pa.	A. Stein Buchanan.
Baumeister, George Elmer,	York,	Pa.	B. S. Gilbert.
Beauchamp, Roscoe Franklin,	Baltimore,	Md.	Chris. Petzelt, dec'd.
Beckmeyer, Wm. Fred. Godlop,	York,	Pa.	A. S. Besore.
Bell, Robert Nevens,	Kearney,	Neb.	S. A. D. Henline.
Benner, Fred. James,	Bethlehem,	Pa.	Paul Kempsmith.
Berberich, Joseph Herman,	Stein,	Germany.	James Moffet, Jr.
Bird, Agustin.	Guayama,	Porto Rico.	
Boesch, Theodore, Karl Henry,	York,	Pa.	A. H. Lafean & Bro.
Boltz, Paul Kline,	Philadelphia,	Pa.	Elias K. Boltz.
Boysen, Theophilus Henry,	Egg Harbor,	N. J.	T. H. Boysen.
Brenner, Frederick Arthur,	Kylertown,	Pa.	Lawson C. Funk.
Caldwell, Edison Ray,	Mt. Vernon,	Ohio.	Edward Dever.
Cathie, Frank Leslie,	Chester,	Pa.	Wm. H. Farley.
Clabaugh, Boyd Van Tries,	Altoona,	Pa.	W. H. Irwin.
Collins, Lane Verlenden,	Philadelphia,	Pa.	John P. Frey.
Cone, Earl Hobart,	Batavia,	N. Y.	W. S. & J. J. Patterson.
Converse, Howard Romaino,	Picture Rocks,	Pa.	Moyer Bros.
Corson, Harry Leroy,	Jersey Shore,	Pa.	B. E. Staples.
Crider, William Edward,	Lock Haven,	Pa.	Chas. Leedom.
Davis, Royal Samuel,	Charlestown,	W. Va.	Thomas & Potterfield.
Davis, William Brown.	Edwardsdale,	Pa.	Daniel E. Lewis.
Doan, Chester Clayton,	Philadelphia,	Pa.	Geo. J. Pechin.
Eckels, Paul,	Decatur,	Ill.	Eberly Bros.
Eddy, Roswell Martin,	Philadelphia,	Pa.	Henry C. Eddy.
Eppler, George Theodore,	Philadelphia,	Pa.	E. E. Wilson & Co.
Fegley, Florence Augusta,	Allentown,	Pa.	Dr. Fegley & Bro.
Fegley, John Stauffer,	Allentown,	Pa.	Dr. Fegley & Bro.
Fischer, Adolph Gustav,	Philadelphia,	Pa.	Albert Oetinger.
Fisher, George Calvin,	Lititz	Pa.	Dr. James C. Brobst.
Fleming, Samuel Clarkson,	York Co.,	Pa.	Chas. A. Eckels.
Foehl, Philip Charles,	Lancaster,	Pa.	J. H. Fies.
Foster, John Van Valzah,	Lewistown,	Pa.	J. P. Rothermel.
Franceschi, Andres,	Porto Rico.		
French, Rolland Hall,	Salem,	Ohio.	Bolger & French.
Garber, Elmer Franklin Weaver,	Mt. Joy,	Pa.	C. A. Eckels.
Gliem, Harry Charles,	Hazleton,	Pa.	McNair & Hoagland.
Graham, Willard,	Philadelphia,	Pa.	Smith, Kline & French Co.
Grove, Harry Ross,	Alexandria,	Pa.	
Harbord, Kittie Walker,	Salem,	Ore.	Daniel J. Fry.
Harding, Joseph Garfield,	New York,	N. Y.	
Harris, Wm. Kuester Garfield,	Altoona,	Pa.	A. F. Shomberg.

Name.	*Place.*	*State.*	*Preceptor.*
Hart, Lawrence Sylvester,	Philadelphia,	Pa.	
Hartung, Edward William,	Philadelphia,	Pa.	R. W. Maris.
Hassinger, Samuel Reed,	Philadelphia,	Pa.	S. E. R. Hassinger.
Haydock, Mabelle,	Philadelphia,	Pa.	Susannah G. Haydock.
Headings, Prestie Milroy,	Reedsville,	Pa.	
Highfield, Herbert Monroe,	Zanesville,	Ohio.	N. B. Adams.
Hild, John Henry,	Philadelphia,	Pa.	Walter S. Rumsey.
Hinski, Oscar Nicholas,	Philadelphia,	Pa.	H. G. Kalmbach.
Hoffert, Charles Edward,	Millersville,	Pa.	Chas. E. Keiler.
Hoffman, Ira Calvin,	Somerset Co.,	Pa.	H. B. Heffley.
Houston, Franklin Paxson,	West Grove,	Pa.	Nellie Baker.
Hubler, Guy Garfield,	Gordon,	Pa.	J. E. Gregory.
Klopp, Edward Jonathan,	Richland,	Pa.	P. M. Ziegler.
Knerr, Charles George,	Allentown,	Pa.	G. W. Shoemaker & Co.
Kraus, O to Lewis,	New Haven,	Conn.	Otto Kraus.
Krieger, Herman Henry,	Ulnow,	Austria.	Ira P. Amick.
Leib, Wilbur John,	York,	Pa.	John P. Frey.
Leiby, Howard Edward,	Philadelphia,	Pa.	Frank G. Mumma.
Lesher, Benjamin Porter,	Chambersburg,	Pa.	Andrew Blair & Co.
Levering, John Hartranft,	Norristown,	Pa.	J. C. Life.
Lewis, Fielding Otis,	Hebbardsville,	Ky.	R. M. McFarland.
Liebert, Louis William,	Philadelphia,	Pa.	H. Clapham.
Link, Edward Frederick,	Evansville,	Ind.	H. B. Morse.
Luddy, James Darrah,	Philadelphia,	Pa.	Frank P. Streeper.
Lynch, Hardie,	Salt Lake City,	Utah.	S. W. Scarff.
McAnally, James Joseph,	Philadelphia,	Pa.	
McClintock, George Washington,	Key West,	Fla.	
McClurg, Benjamin Hoffer,	Elizabethtown,	Pa.	A. H. Bolton.
McDermott, Robert Joseph,	Trenton,	N. J.	Dr. Sands.
McFadden, Warren Lester,	Philadelphia,	Pa.	Duble & Cornell.
McHale, James Joseph,	Shenandoah,	Pa.	Paul W. Houck.
McLaughlin, Harry A.,	Philadelphia,	Pa.	N. Richardson.
Macphee, John James,	New Glasgow,	Nova Scotia,	T. D. Macphee.
Mann, Harvey,	Yeagertown,	Pa.	
Matlack, Walter Ball,	Bridgeton,	N. J.	Alfred N. Pierson,
Mauger, Harry Fillman,	Pottstown,	Pa.	J. D. Seiberling.
Michels, Victor Clyde,	Albion,	Ill.	B. F. Michels.
Monaghan, Martin Vincent,	Shenandoah,	Pa.	Paul W. Houck.
Murphey, Edwin Mason,	Macon,	Miss.	T. S. Murphey.
Musser, Guy Musselman,	Witmer,	Pa.	R. W. Cuthbert
Nauss, George Hill,	Steelton,	Pa.	Wm. K. Martz.
Noble, Henry Carty,	Philadelphia,	Pa.	Howard M. Levering.
Otter, Wm. Proudly, Jr.,	Philadelphia,	Pa.	H. B. Weaver.
Penrose, Thomas William,	Philadelphia,	Pa.	F. W. E. Stedem.
Picking, Jacob Sylvester,	Somerset,	Pa.	G. W. Benford.
Pittinger, Charles A.,	Freehold,	N. J.	Edwin G. Bacon.
Pflieger, Adam William,	York,	Pa.	A. L. Ziegler.
Pollins, Harry Geo. Lomison,	Greensburg,	Pa.	
Post, Arthur Edward,	Towanda,	Pa.	F. Elmer Post.
Quick, Harry Lull,	Titusville,	Pa.	E. K. Thompson & Son.
Raser, William Heyl, 2d,	Reading,	Pa.	John B. Raser.
Redcay, Franklin,	Pottsville,	Pa.	C. D. Miller, M.D.
Reinhart, John Quigley,	Shepherdstown,	W. Va.	H. B. Morse.
Reynolds, Clarence Hyatt,	Reynoldsville,	Pa.	S. Reynolds, M.D.
Rhoads, Luther K.,	Reading,	Pa.	Chas. H. Raudenbush.
Richardson, Edward Miller,	Camden,	N. J.	Emma M. Richardson, M.D.
Rinker, William,	Hellertown,	Pa.	T. E. Jacobson.
Rittman, Joseph,	Lock Haven,	Pa.	G. W. Mason.
Roberts, George William,	Philadelphia,	Pa.	Wm. R. Warner & Co.
Rogers, Walter Clyde,	West Chester,	Pa.	F. P. Rogers.

Name.	Place.	State.	Preceptor.
Rolland, Alexander, Jr.,	Philadelphia,	Pa.	G. H. Rolland.
Ryan, Thomas Andrew,	Susquehanna,	Pa.	
Saile, Wendelin.	Wilkesbarre,	Pa.	Thomas Hart.
Sandt, Warren Norwood,	Martins Creek,	Pa.	A. J. Odenwelder.
Saul, Irvin Ellsworth,	Windsor Castle,	Pa.	Jesse W. Pechin.
Schaefer, George,	Philadelphia,	Pa.	J. A. Werckshagen.
Schaffer, Charles Abraham,	Slatington,	Pa.	R. W. Young, M.D.
Schepp, William Frederick,	Wheeling,	W. Va.	George H. Ebeling.
Schmerker, Adolph Alex. Beyer,	Allentown,	Pa.	F. G. Wedemeyer.
Schneider, Emil Sebastian,	Philadelphia,	Pa.	Philip Goll.
Schooley, Joseph Griggs,	Montgomery,	Pa.	J. L. Miller.
Schropp, John Krause Reinoehl,	Lebanon,	Pa.	Chas. H. Blouch.
Scott, Henry William,	Waynesburg,	Pa.	A. E. Brock, M.D.
Shafer, Clarence Eugene,	Altoona,	Pa.	H. L. Stiles.
Shannon. Byron Guest,	Penns Grove,	N. J.	A. C. Schofield.
Shaver, David Oscar,	Altoona,	Pa.	F. L Akers.
Shenkle, Albert Philip,	Phœnixville,	Pa.	Michael R. Shenkle.
Shields, Percy Way,	West Chester,	Pa.	Wm. A. Pierce.
Shoffner, John Perry,	S. Bethlehem,	Pa.	T. H. Potts, M.D.
Skillman, Lionel Gilliland,	Philadelphia,	Pa.	Shoemaker & Busch.
Slocum, Charles Eben,	Ouray,	Col.	C. C. Stratton.
Sparks, Theodore Burrows,	Burlington,	N. J.	E. R. Sparks.
Spears, Edward Gibson,	Reading,	Pa.	Harry H. Kline.
Sprague, Hugh Boleyn,	Salt Lake City,	Utah.	Druehl & Franken.
Steever, William Forsaith,	Millersburg,	Pa.	Chas. C. Steever.
Stein, Joseph Paul,	Philadelphia,	Pa.	Crumbie Bros.
Stoudt, Irwin Sylvester,	Obold,	Pa.	George Y. Wood.
Strathie, Alexander John,	Handcross Sussex,	England.	Wm. J. Jenks.
Texter, Charles Henry,	Perkasie,	Pa.	Henry Neamand.
Thomas, Wallace Crouch,	Thomas,	Pa.	M. B. Fretz.
Tingle John Beard,	Dayton,	O.	Edwin M Boring.
Tyler, Joseph Clark,	Mt. Sterling,	Ky.	D. H. Ross.
Unangst, Stuart Levin,	Butztown,	Pa.	Harvey F. Hess.
Urffer, Samuel,	S. Bethlehem,	Pa.	D. W. H. Sheets.
Van Gilder, Levi,	Petersburg,	N. J.	C. B. McLaughlin.
Watson, Herbert James,	Wilmington,	Del.	H. K. Watson.
Westermayer, John Joseph,	Philadelphia,	Pa.	L. S. A. Stedem.
Wolfer, William Conard,	Philadelphia,	Pa.	Ed. C. Stout.
Wolfinger, John Philip,	Reading,	Pa.	Harry J. Schad.
Ziegler, Charles Harry,	York,	Pa.	Nelson B. Fry.

SECOND YEAR CLASS LIST.

Name.	Place.	State.	Preceptor.
Albright, Allen Enos,	Allentown,	Pa.	Henry Medd, M.D.
Andrews, William Hall,	Woodstown,	N. J.	Geo. M. Andrews.
Austin, Charles Howard,	Woodstown,	N. J.	Theodore Campbell.
Baker, Maineard Lesher,	Cowan,	Pa.	C. W. Albright.
Barker, Laura Alice,	Coalport,	Pa.	G. W. Wood.
Beardsley, Edward John,	Hartford,	Conn.	Chas. A. Rapelye.
Beatty, Arthur William,	St. Louis,	Mo.	H. C. Blair.
Bishop, William H. Pancoast,	Carversville,	Pa.	J. H. Bishop, M.D.
Blew, Joseph Oscar,	Bridgeton,	N. J.	Chas. F. Dare & Son.
Borrowes, George Henry,	Philadelphia,	Pa.	Henry C. Blair.
Bosler, Harry Ellis,	Oleon,	N. Y.	J. C. Welch.
Bowers, Howard Levin,	Easton,	Pa.	H. B. Semple & Son.
Branin, Manlif Lewis,	Millville,	N. J.	C. B. McLaughlin.
Brennan, Edward Vincent,	Plymouth,	Pa.	L. W. Rehbeen.

Name.	*Place.*	*State.*	*Preceptor.*
Brookes, Virginia Cade,	Waelder,	Texas.	Susan Hayhurst, M.D.
Brooks, Walter,	Quarryville,	Pa.	T. M. Rohrer.
Buckman, William Watson,	Newton,	Pa.	Harry Cox.
Burchfield, William Clinton,	Ashland,	Pa.	R. J. Williams.
Carey, Harris May,	Wyoming,	Del.	N. O. Harris.
Cartwright, Sanford Warren,	Fresno,	Cal.	J. Lawson Crowthers.
Casperson, Henry Lyle,	Clayton,	Del.	E. F. Kaempfer.
Connell, Francis Joseph,	Pottstown,	Pa.	Chas. A. Eckels.
Cook, Ernest Fullerton,	Camden,	N. J.	Geo. M. Beringer.
Corson, Thomas Clark,	Philadelphia,	Pa.	W. J. Scott.
Craig, Henry Douglas,	Mauch Chunk,	Pa.	J. W. Smith.
Dentler, Roy W.,	Turbotville,	Pa.	Frank W. Ely.
Desch, Edward Allen,	Fogelsville,	Pa.	C. J. Biddle.
Dietz, Harry Edgar,	Lock Haven,	Pa.	Geo. W. Mason.
Doake, Robert Stewart,	Philadelphia,	Pa.	Theodore Campbell.
Dobson, Leonard Stanton,	Philadelphia,	Pa.	C. L. Dobson.
Dooley, John Joseph,	Plymouth,	Pa.	Geo. J. Durbin.
Dorman, Harry Milton,	Phœnixville,	Pa.	W. A. Dorman.
Doughty, John Thompson,	Millville,	N. J.	J. Addison Eberly.
Duffy, Thomas Anthony,	Carbondale,	Pa.	B. A. Kelly.
Dunn, Edwin Alfred,	Meadville,	Pa.	P. Henry Utech.
Eddy, Eugene Henry,	Lorain,	O.	John H. Folkens.
Edwards, Manly Bruce,	Bloomsburg,	Pa.	Geo. P. Ringler.
Eldridge, William Arthur,	Salem,	N. J.	Frank Luersson.
Eshleman, Ellis Good,	Faggs Manor,	Pa.	C. W. Warrington.
Fabian, Asa,	Ottsville,	Pa.	R. H. Lackey.
Faunce, George Castor,	Philadelphia,	Pa.	T. W. Hargreaves.
Fiet, John Jacob,	Philadelphia,	Pa.	H. J. Fiet, M.D.
Fisher, John Anthony,	Tremont,	Pa.	J. H. Shultz.
Fox, Harry Terry,	Zanesville,	O.	Wm. M. Chappelear & Sons.
Franke, Louis,	Johnstown,	Pa.	C. G. Campbell.
Garritt, Henry James,	Huron,	O.	J. M. Garritt.
Gibble, John Harry,	Manheim,	Pa.	Elmer E. Gibble, M.D.
Goodyear, Harry Jacob,	Lebanon,	Pa.	J. L. Lemberger.
Greenberg, Jacob,	Novomirgorod,	Russia.	M. Peissakovitch.
Griest, Joseph Taylor,	Peoria,	Ill.	Wm. Benton.
Guest, Wilbert Hillman,	Woodstown,	N. J.	Harry Guest.
Hampson, William Harvey,	Philadelphia.	Pa.	F. F. Drueding.
Hand, Wilson Howe,	Dixon,	Ill.	W. R. McGeorge.
Harmony, Edmund Franklin,	Allentown,	Pa.	
Harrison, Walter B.,	McKeesport,	Pa.	J. C. Smith.
Hauber, Christian Henry,	Philadelphia,	Pa.	F. W. Haussmann.
Heinze, George Elmer,	Ashland,	Pa.	August Schoenenberger.
Hemberger, Paul Edward,	Dayton,	O.	John N. Prass.
Hilbish, John Henry,	Fredericksburg,	Pa.	J. C. Greisemer.
Hillebrand, William Gustav,	Philadelphia,	Pa.	Wm. N. Seary.
Hires, Lewis Moore,	Bridgeton,	N. J.	Reed & Fithian.
Holmes, Frederick Cost,	Dover,	Del.	Andrew Blair & Co.
Housholder, Charles Edward,	Harrisburg,	Pa.	Frank S. Keet.
Hughes, Harry Wilbert,	Millville,	N. J.	H. A. Nolte.
Hunsinger, Merton Acto,	North Mehoopany,	Pa.	
Irby, Moreland Russell,	Ashland,	Va.	N. Knight.
Jaeger, William Clark,	Philadelphia,	Pa.	Carl H. Bohn.
Jelliff, Glenn Eli,	Mansfield,	Pa.	W. H. Braddock.
Kazanjian, Rupen Hagop,	Adana,	Armenia.	R. Hambleton, M.D.
Kelly, Edward Jochin,	Philadelphia,	Pa.	L. S. A. Stedem.
Kiefer, William Frederick,	Philadelphia,	Pa.	H. G. Comp & Co.
Kilgus, Harry Edward,	Renovo,	Pa.	Estate of M. L. Clay.
King, Lloyd Stanley,	Dayton,	O.	Wm. P. Graybill.
Landauer, Oscar,	Philadelphia,	Pa.	Theodore Sprissler, M.D.

Name.	*Place.*	*State.*	*Preceptor.*
Lawn, John Thomas,	Philadelphia,	Pa.	F. W. E. Stedem.
Lehman, Samuel William,	Shippensburg,	Pa.	J. C. Altick & Co.
Lum, William Alvin,	North East,	Md.	Francis E. Harrison.
McCaffry, Ward Bolon,	Berkeley Springs,	W. Va.	Thos. E. Hodgson.
McClure, Charles Nevin,	York,	Pa.	L. K. Slifer.
McElwain, William Thomas,	Chambersburg,	Pa.	Chas. W. Keefer.
Mackey, Joseph Quarll,	Avondale,	Pa.	Lawson C. Funk.
Magee, Michael Vincent,	Conshohocken,	Pa.	Thos. F. McCoy.
Maier, Frank Joseph,	Woodbury,	N. J.	Alfred S. Marshall.
Manges, Willis Fastnecht,	Felton,	Pa.	W. H. Gano.
Meredith, Harry Lionel,	Hagerstown,	Md.	D. C. Aughinbaugh & Son.
Merz, Alfred William,	Wurtenburg,	Germany	E. W. Herrmann.
Meuser, Charles John,	Easton,	Pa.	C. L. Bachmann.
Michael, George Albert,	Lebanon,	Pa.	Chas. E. Boger.
Miles, James Barzillai, Jr.	Helena,	Ark.	
Moeller, Carl Frederick,	Schilleswig Holstein,	Germany,	Dr. Hickman.
Morgan, Lulu Annette,	Scranton,	Pa.	Matthews Brothers.
Morris, William Torrey, 2d,	Penn Yan,	N. Y.	T. F. Wheeler.
Ohliger, Willard,	Wooster,	O.	Zimmerman & Co.
Peiffer, Arthur,	Philadelphia,	Pa.	Steltz & Co.
Pursel, Robert Clayton,	Bloomsburg,	Pa.	Moyer Brothers.
Quinn, Francis Dennis,	Johnsonburg,	Pa.	E. H. Hyatt.
Rectenwald, Daniel Lewis,	Pittsburg,	Pa.	F. W. E. Stedem.
Rhoad, Irwin Bieber,	Kutztown,	Pa.	Funk & Groff.
Richards, Daniel Arthur,	South Easton,	Pa.	A. J. Odenwelder.
Ricketts, Clarence Emerson,	Kane,	Pa.	E. H. Watkins.
Russell, Walter Harold,	Philadelphia,	Pa.	S. Harry Conover.
Ryan, William Thomas,	Honesdale,	Pa.	R. Duane Reed.
Saurman, James S.,	Norristown,	Pa.	Baker & Grady.
Schad, Frank Casper,	Tamaqua,	Pa.	L. J. Steltzer.
Schmidt, Oscar Carl,	Philadelphia,	Pa.	G. A. Barwig.
Scott, John Calvin,	Hamburg,	Pa.	A. J. Fink.
Scott, Levi,	Camden,	Del.	Wilkinson & Wilkinson.
Seabold, Harry Adam	Fahnestock, Annville,	Pa.	W. S. Seabold.
Seip, Charles Louis,	Philadelphia,	Pa.	Geo H. Ochse.
Settle, Peter Smith,	Philadelphia,	Pa.	T. H. Price, M.D.
Seward, Frank Gates,	Norwich,	N. Y.	Norwich Pharmacal Co.
Siegle, Herman Christian,	Peoria,	Ill.	A. W. H. Reen.
Smiley, Frances Jane,	Philadelphia,	Pa.	Susan Hayhurst, M.D.
Smith, George Carroll,	Pottstown,	Pa.	Eberly Brothers.
Speck, Herbert Arthur,	Bethlehem,	Pa.	Paul Kempsmith.
Stacks, Abraham Homer,	York,	Pa.	J. C. Perry.
Stern, Wilson Clinton Ammon,	Philadelphia,	Pa.	D. Bruce Richards.
Stinson, William Samuel,	Titusville,	Pa.	Geo. B. Evans.
Stolz, Louis,	Syracuse,	N. Y.	G. E. Thorpe.
Stone, Edward Browning,	Camden,	N. J.	Wm. Shafer.
Stout, Benjamin Franklin,	Quakertown,	Pa.	N. S. Steltzer.
Sullivan, James Francis,	Hartington,	Neb.	G. H. West.
Sunday, Carlton Pierce,	York,	Pa.	R. Wm. Ziegler.
Taylor, Lynwood S.,	Spring City,	Pa.	W. Carroll Taylor.
Timmins, Carroll Edwin,	Gettysburg,	Pa.	James Huston.
Toon, John Louis,	Evergreen,	La.	Chas. A. Scribner.
Tucker, Robert Woodliff,	Bermuda Islands,		J. K. Freeman.
Waidley, Harvey Leroy,	Erie,	Pa.	Geo. D. Reavley.
Wenner, Harvey Eugene,	Allentown,	Pa.	A. R. Hesske.
Werts, John Lamont,	Rerovo,	Pa.	J. F. Neely.
Wilkinson, Harry,	Philadelphia,	Pa.	W. H. Milliken.
Williams, Joseph James,	Conshohocken,	Pa.	John W. Pilgrim.
Wilson, George Cookman, Jr.,	Reading,	Pa.	J. C. Sanderson.
Witman, Charles Daniel,	Middletown,	Pa.	J. W. Rewalt.

Name.	*Place.*	*State.*	*Preceptor.*
Witmeyer, Samuel David,	Lebanon,	Pa.	Shinn & Baer.
Young, Alexander, Jr.,	Jenkintown,	Pa.	Samuel C. Henry.
Young, Edwin Henry,	So. Bethlehem,	Pa.	Cyrus Jacoby.
Zeller, Harry Lewis,	Tremont,	Pa.	Russell T. Blackwood.

THIRD YEAR CLASS LIST.

Name.	*Place.*	*State.*	*Preceptor.*
Allen, Milton Deronda,	Medford,	N. J.	D. W. Flemming.
Andrews, Willard Crandall,	Cortland,	Ohio.	W. C. Andrews.
Arnott, William,	Wilmington,	Del.	Joseph P. Williams.
Aughinbaugh, John Keely,	Green Village,	Pa.	Eberly Bros.
Bachman, Herbert Keck,	So. Bethlehem,	Pa.	D. W. Ross.
Ball, Clifford Arthur,	Hellertown,	Pa.	Ellwood Ball, dec'd.
Balliet, Howard Paul,	Bethlehem,	Pa.	D. Geo. Kocher.
Bamford, Melvin William,	Reading,	Pa.	R. Powers Wilkinson.
Bayles, John Wyckoff,	Mt. Holly,	N. J.	A. J. Durand.
Bear, Benjamin Samuel Janney,	Mt. Joy,	Pa.	S. H. Shingle.
Beddow, Llewellyn Jenkins,	Mahanoy City,	Pa.	M. R. Stein.
Blankemeyer, Henry John,	Philadelphia,	Pa.	Kennedy & Burke.
Booth, John Henry,	Philadelphia,	Pa.	Long & Co.
Brookes, Lulu,	Waelder,	Texas,	J. M. & J. C. Henderson.
Buckingham, Harry Sheldon,	Clayton,	N. J.	Howard G. Shinn.
Chalquest, Gustav Emil,	Morristown,	N. J.	E. A. Carrell.
Chamberlain, Lowell Holbrook,	Des Moines,	Iowa.	Irving C. Wood, M.D.
Chamberlin, William Allen,	Indianapolis,	Ind.	Frank Morse.
Clark, John Edward,	Lock Haven,	Pa.	Franciscus & Co.
Cockroft, David Holiday,	Philadelphia,	Pa.	A. S. Hollopeter.
Cohen, John Thomas,	Chester,	Pa.	R. H. Henderson.
Crain, Charles Edward,	Springfield,	Ohio.	G. & S. Coblentz.
Crawford, Horace Victor,	Mifflinburg,	Pa.	E. F. Menger.
Culby, Walter Gibson,	Philadelphia,	Pa.	Breidinger & Comber.
Curtis, Henry,	Minneapolis,	Minn.	Oan J. Thompson, M.D.
Davis, B. K.,	St. Joseph,	Mo.	Muswick & Co.
Davis, Benjamin Winter,	Camden,	N. J.	G. L. Geiger & Co.
Davis, Samuel Bond,	Bridgeton,	N. J.	A. LaDow & Co.
Diehl, George Edward,	Charlestown,	W. Va.	Light & Watson.
Dixon, John Glaspey,	Salem,	N. J.	J. H. Lock, M.D.
Doherty, Harry Aloysius,	Atlantic City,	N. J.	F. Elmer Post.
Donnelly, Clarence Eugene,	Bridgeton,	N. J.	Frederick Seitz, M.D.
Doubler, George Hougen,	Milton,	Pa.	Robert W. Maris.
Downing, William Henry,	Wilmington,	Del.	N. C. Danforth.
Egel, Frederick William,	Bound Brook,	N. J.	Charles L. Manning.
Falkenhainer, Charles, Jr.,	Guttenburg,	Iowa.	James Hervey.
Faulhaber, Gustav Adolph,	Loudenville,	Ohio.	G. Appenzeller.
Fishburne, Richard Levis,	Lock Haven,	Pa.	Andrew Blair & Co.
Fleming, Arthur Bowles,	Chambersburg,	Pa.	J. S. Barnitz.
Gasslein, Richard Joseph,	Philadelphia,	Pa.	James J. Ottinger.
Grady, William Patrick,	Philadelphia,	Pa.	F. W. E Stedem.
Gruel, John Edward,	Lancaster,	Pa.	John C. Long, dec'd.
Gryning, John Francis,	Philadelphia,	Pa.	George B. Evans.
Hammond, Nathan Browne,	West Chester,	Pa.	Arthur B. Hammond.
Hance, Howard Ivins,	Philadelphia,	Pa.	R. A. Hance.
Hannum, John Lewis,	Media,	Pa.	Wm. E. Dickeson.
Hartman, Henry Loekle,	Lebanon,	Pa.	Dr. Geo. Ross & Co.
Harvey, Charles John,	Butler,	Pa.	D. H. Waller.
Heckman, John George,	Meadville,	Pa.	Lindeman & Heckman.
Heineberg, Alfred,	Selma,	Ala.	Selma Drug Co.

Name.	*Place.*	*State.*	*Preceptor.*
Hesse, Frederick William,	Savannah,	Ga.	Reid & Co.
Hetrick, Harry Leady,	Altoona,	Pa.	W. M. C. Craine.
Heyl, Charles Ambrose,	Philadelphia,	Pa.	P. M. Kelly, M.D.
High, Raymond,	Norristown,	Pa.	H. L. Stiles.
Hill, George Price,	Lansford,	Pa.	Wm. M. Hill.
Hoagland, Robert John,	Peoria,	Ill.	Geo. Holland, M.D.
Hoch, Quintus,	Nazareth,	Pa.	Aquila Hoch.
Holland, Albert James Fowler,	Philadelphia,	Pa.	Geo. Holland, M.D.
Holt, Edwin Merrimon,	Goldsboro,	N. C.	George B. Evans.
Hottenstein, Peter David,	Kutztown,	Pa.	E. J. Sellers.
Huzzard, Kurtz,	Norristown,	Pa.	Eugene Fillman.
Jackson, Charles Henry,	Salem,	N. J.	Harry Lippen.
James, Arthur Bernstein,	Kingstown,	N. Y.	J. Wohlgemuth.
Jenkins, David Evans,	Danville,	Pa.	H. C. Blair.
Kaderly, Eugene John,	New Philadelphia,	O.	Opes & Thompson.
Keiser, Frederick Ilick,	Milton,	Pa.	C. Carroll Meyer.
Kemp, Lucien Scott,	Dayton,	O.	Wm. Procter, Jr., Co.
Kimberlin, Frederick William,	Norristown,	Pa.	Chas. B. Ashton.
Kincaid, Raymond Keck,	Allentown,	Pa.	Harvey L. Kieper.
Kintzer, Harry Augustus,	Womelsdorf,	Pa.	F. T. Landis.
Klusmeyer, Harry Chester,	Easton,	Pa.	Fred. L. Mebus.
Koch, Christopher, Jr.,	Philadelphia,	Pa.	C. A. Eckels.
Kraus, Wm. Fred. Constantine,	Philadelphia,	Pa.	Otto Kraus.
Krehl, Benjamin,	Buffalo,	N. Y.	Theo. W. Reuting.
Lacy, Burdett Seldon,	Philadelphia,	Pa.	Wm. E. Lee.
Lauer, Julius Paul,	Scranton,	Pa.	Chas. E. Keeler.
Lehman, George Theodore,	Portsmouth,	O.	Fisher & Streich.
Lock, William,	Philadelphia,	Pa.	James Huston.
Love, Thomas B.,	Philadelphia,	Pa.	Bullock & Crenshaw.
McClintock, Theodore Brown,	Jamestown,	N. Y.	Hatch & Briggs.
McClure, Richard Lewis,	Wilmington,	Del.	F. R. Smith, M.D.
McCollin, James Garrett,	Philadelphia,	Pa.	J. Lawson Crothers.
McDonnell, Joseph Francis,	Centralia,	Pa.	G. W. Davis.
McFall, John Allen,	Charleston,	S. C.	Henry M. Minton.
MacMurray, Annie,	Upland,	Pa.	Wm. H. Farley.
MacPherran, Ivan LeRoy,	Pittsburg,	Pa.	M. M. Dunham.
Mattison, Richard Van S., Jr.,	Ambler,	Pa.	Richard V. Mattison, M.D.
Mervine, Graydon Duncan,	Milton	Pa.	J. S. Follmer, M.D.
Moury, Joseph Daniel,	Shamokin,	Pa.	L. W. Hensyl, M.D.
Mutty, Walter Clement,	South Brewer,	Maine.	F. W. E. Stedem.
Nicklas, David Edwards,	Chambersburg,	Pa.	John L. Barnitz.
Osterlund, Otto William,	Kinekulle,	Sweden,	Theodore Campbell.
Patrick, William Smith,	Salem,	N. J.	Wm. H. Dunn.
Pflieger, Elwood Keech,	York,	Pa.	Dale, Hart & Co.
Price, Arthur Chew,	Wilmington,	Del.	Joseph C. Roberts.
Radefeld, Robert Hugo,	Philadelphia,	Pa.	Fredk. C. Radefeld.
Ranck, David Walter,	Philadelphia,	Pa.	J. W. Ranck, M.D.
Roessner, Benjamin,	Philadelphia,	Pa.	Decatur Milligan.
Rogers, Edward Bancroft,	Mt. Holly,	N. J.	Elmer D. Prickett.
Ross, Dell Noblet,	Rosemont,	Pa.	Frank W. Prickett.
Rossell, Edward Wood,	Springfield,	N. J.	W. Setgraves.
Ryan, William Stephens,	Philadelphia,	Pa.	A. D. Forrest.
Saylor, Byron Centennial,	Annville,	Pa.	E. C. Warg.
Schwaemmle, Fred. Philip,	Philadelphia,	Pa.	Edward H. Fienhold.
Seitz, John Alphonsus,	Wilmington,	Del.	Z. James Belt.
Seubert, Charles Aloysius,	Lebanon,	Pa.	John F. Loehle.
Shannon, Samuel Coward,	Philadelphia,	Pa.	D. M. Harris.
Shapiro, Henry,	Vitebsk,	Russia.	F. W. E. Stedem.
Sheehan, William Henry,	Dallas City,	Pa.	Harry M. Campbell.
Shirey, Orville Ludwig,	Chambersburg,	Pa.	Cressler & Keefer.

Name.	*Place.*	*State.*	*Preceptor.*
Shoults, Robert Grafton, Ph.G.	Napa,	Cal.	M. Bourgongun.
Sipes, Clarence Leslie,	McConnellsburg,	Pa.	C. P. Landis.
Smith, Arthur Nelson, Ph.G.,	Port Allegany,	Pa.	J. Herbert Williams.
Smith, Chas. Elwood Rupert,	Philadelphia,	Pa.	Shoemaker & Busch.
Snyder, Herman Hugo,	Philadelphia,	Pa.	Frank C. Davis.
Stahlé, Robert Nevin,	Gettysburg,	Pa.	Henry A. Borell.
Stang, Peter,	Philadelphia,	Pa.	Henry Mueller, M.D.
Steel, Chalmers Alexander,	Huntingdon,	Pa.	H. E. Steel.
Stout, Philip Samuel,	Quakertown,	Pa.	O. A. Stout, M.D.
Strode, R. Clark,	Philadelphia,	Pa.	Funk & Groff.
Turner, Joseph Constantine,	Philadelphia,	Pa.	Wm. H. Deibert.
VanDyke, James Wilber,	Hightstown,	N. J.	Harvey G. Rue.
Watson, James Nathaniel,	Elizabethtown,	Pa.	H. C. Blair.
Weakley, William Stair,	York,	Pa.	John J. Weakley.
Wehn, Clyde Edwards,	Johnstown,	Pa.	Charles Young.
West, Katherine Powell,	Norristown,	Pa.	Joseph C. Roberts.
Wiza, Joseph Louis,	Philadelphia,	Pa.	W. H. F. Vandergrift.
Wyckoff, Elmer LeRoy,	Ithaca,	N. Y.	Fred. H. Blackmer.
Young, Annie Hawkins,	Henderson,	N. C.	Geo. B. Evans.
Zeller, Earl Emanuel,	Mifflinburg,	Pa.	James Kleckner.
Ziegler, Chester Winsor,	Gettysburg,	Pa.	Shinn & Baer.

SENIORS.

Name.	*Place.*	*State.*	*Preceptor.*
Becht, Frederick,	Philadelphia,	Pa.	Bullock & Crenshaw.
Entwistle. Albert Henry,	Philadelphia,	Pa.	Chas. H. Roberts.
Failing, W. Clark,	Palatine Bridge,	N. Y.	H. C. Blair.
Filer. Burrett Boynton,	Hammonton,	N. J.	J. Frank Meade, M.D.
Jaeger, Charles Frederick,	Philadelphia,	Pa.	E. E. Bostick.
Jolley, John James,	Philadelphia,	Pa.	Frank M. Apple.
McDonnell, William Joseph,	Philadelphia,	Pa.	Chas. P. McDonnell.
Malin, George Lawrence,	Atlantic City,	N. J.	Willard Wright, dec'd.
Peck, William George,	Nottingham,	England.	J. F. Meade, M.D.
Test, Ellwood Allen,	Philadelphia,	Pa.	John H. Kerr.

SPECIAL STUDENTS.

Name.	*Place.*	*State.*	*Preceptor.*
Chapman, Richard Henry,	Philadelphia,	Pa.	Chemistry.
Crawford, William Harvey,	Ashbourne,	Pa.	Chemistry.
duPont, Ernest,	Wilmington,	Del.	Chemistry.
Eddy, Eugene Henry,	Lorain,	O.	Chemistry.
Hookey, Charles Gilbert,	Philadelphia,	Pa.	Chemistry.
Jaeger, William Clark,	Philadelphia,	Pa.	Chemistry.
Kinzey, Calvin Otto,	Cumberland,	Md.	Chemistry.
McCracken, John Alvin,	Philadelphia,	Pa.	Chemistry.
McMahon, Joseph Alphonsus,	Lock Haven,	Pa.	Chemistry.
Roberts, John Austin,	Wilmington,	Del.	Chemistry.
Stolz, Louis,	Syracuse,	N. Y.	Chemistry.
Suess, Ignatz,	Grand Meseritsch,	Austria.	Chemistry.
Toplis, William G., Ph. G.,	Philadelphia,	Pa.	Chemistry.
Weaver, Christian,	Nastved,	Denmark.	Chemistry.
Wirth, Adam,	New Orleans,	La.	Chemistry.